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Machine and Plant Safety Seminar

Agenda

1. Machine Safety Standards 9.00-9.30

2. Lockout Tagout 9.30-10.00

3. Arc Flash 10.00-10.30

Break 10.30-10.45

4. Integrated Safety Solutions 10.45-11.15

5.Safety Tools 11.15-11.45

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LISTEN. THINK. SOLVE.®

Functional Safety

Wayne Pearse
Safety Consultant
FSExpert (TÜV Rheinland, Machinery)
FSEngineer (TÜV Rheinland, Machinery)

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Agenda

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1. AS/NZS 4024:2014 Update
2. AS/NZS 4024:1503 (ISO 13849:2006)
3. Machine Safety / Functional Safety
4. TÜV Functional Safety Training
5. Safety Services

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1. AS/NZS 4024:2014 Update
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AS4024:2006

- AS4024:2006 was made up of 26 parts based on International Standard.

The new AS 4024.1-2006 Safety of machinery standard

The new AS 4024.1-2006 is basically made up of these 26 International Standards. The list below shows the equivalent International Standards.

AS 4024.1-2006 Part No. …	Equivalent ISO/IEC/EN Standard	Title Safety of machinery
1101	EN 1070	Terminology - General
1201	ISO 12100.1 / EN 292.1	General principles-Basic terminology and methodology
1202	ISO12100.2 / EN 292.2	General principles-Technical principles
1301	ISO 14121 / EN 1050	Risk assessment-Principles of risk assessment
1302	EN 626	Risk assessment-reduction of risks to health and safety from hazardous substances emitted by machinery-Principles and specifications for machinery manufacturers
1401	EN 614	Ergonomic principles-Design principles-Terminology and general principles
1501	ISO 13849.1 / EN954.1	Design of safety related parts of control systems-General principles
1502	ISO 13849.2 / EN 954.2	Design of safety related parts of control systems-Validation
1601	ISO 14120 / EN 953	Design of controls, interlocks and guarding-Guards-General requirements for the design and construction of fixed and movable guards
1602	ISO 14119 / EN 1088	Interlocking devices associated with guards-Principles for design and selection
1603	ISO 14118 / EN 1037	Design of controls, interlocks and guards-Prevention of unexpected start-up
1604	ISO 13850 / EN 418	Design of controls, interlocks and guarding-Emergency stops-Principles for design

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Summary of AS4024:2014 Updates

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- Keeping Australia and New Zealand in line with International Standards; the AS/NZS series of machinery safety standards has been revised and released July 2014.
- The parts are available individually awaiting the release of the application guide part 1100 later this year.
- The parts are direct text adoptions of the international standard; this means all references in the parts refer to international standards numbers.
- Nineteen (19) parts have been superseded 1201, 1302, 1401, 1601, 1602, 1604, 1701, 1702, 1703, 1704, 1801, 1803, 1901, 1902, 1903, 1904,1905, 1906 and 1907; two new chapters have been added (1303, 1503); and four chapters superseded and withdrawn (1101, 1202, 1301, 1802) with the application guide (1100) to follow.

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AS/NZS 4024:2014 Safety of Machinery

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AS/NZS 4024:2014 Part No....	International Equivalent IOC/IEC/EN Standard	Title Safety of Machinery
4024.1100:2014	N/A	Application Guide for the AS 4024.1 series. *Still at drafting stage*
4024.1101-2006	N/A	Available but will not be part of the revised AS 4024.1 series
4024.1201:2014	ISO 12100:2010	This part supersedes the 2006 versions of parts 1201, 1202 and 1301
4024.1202-2006		Superseded by AS 4024.1201:2014
4024.1302:2014	EN 626-1:1994+A1:2008	This part supersedes the 2006 version of part 1302
4024.1303:2014	ISO/TR 14121-2:2012	*New Part:* This part provides guidance on risk estimation
4024.1401:2014	EN 614-1:2006+A1:2009	This part supersedes the 2006 version of part 1401
4024.1501-2006	ISO 13849-1:1999	This part will remain current and unchanged
4024.1502-2006	ISO 13849-2:2003	This part will remain current and unchanged
4024.1503:2014	ISO 13849-1:2006	*New Part:* This part designs control systems to Performance Levels (PL)
4024.1601:2014	EN 953:1997+A1:2009	This part supersedes the 2006 version of part 1601
4024.1602:2014	ISO 14119:2013	This part supersedes the 2006 version of 1602
4024.1603-2006		This part will remain current and unchanged
4024.1604:2014	ISO 13850-2006	This part supersedes the 2006 version of part 1604
4024.1701:2014	ISO 7250-1:2008	This part supersedes the 2006 version of part 1701
4024.1702:2014	EN 547-1:1996+A1:2008	This part supersedes the 2006 version of part 1702
4024.1703:2014	EN 547-2:1996+A1:2008	This part supersedes the 2006 version of part 1703
4024.1704:2014	EN 547-3:1996+A1:2008	This part supersedes the 2006 version of part 1704
4024.1801:2014	ISO 13857:2008	This part supersedes the 2006 version of part 1801 and 1802
4024.1802-2006		Superseded by AS 4024.1801:2014
4024.1803:2014	ISO 13854:1996	This part supersedes the 2006 version of part 1803
4024.1901:2014	EN 894-1:1997+A1:2008	This part supersedes the 2006 version of part 1901
4024.1902:2014	EN 894-2:1997+A1:2008	This part supersedes the 2006 version of part 1902
4024.1903:2014	EN 894-3:2000+A1:2008	This part supersedes the 2006 version of part 1903
4024.1904:2014	IEC 61310-1 Ed 2.0	This part supersedes the 2006 version of part 1904
4024.1905:2014	IEC 61310-2 Ed 2.0	This part supersedes the 2006 version of part 1905
4024.1906:2014	IEC 61310-3 Ed 2.0	This part supersedes the 2006 version of part 1906
4024.1907:2014	EN 981:1996+A1:2008	This part supersedes the 2006 version of part 1907

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Functional Safety Standards

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Application	Standards	Rating
GENERIC Electrical Control Systems	IEC EN AS 61508 Top level standard	SIL Safety Integrity Level
PROCESS Electrical Control Systems	IEC AS 61511	
MACHINERY Electrical Control Systems	IEC EN AS 62061:2006	
MACHINERY Control Systems (All technologies)	AS/NZS 4024:1503 (ISO 13849-1: 2006)	PL Performance Level

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AS/NZS 4024:1503 or AS 62061:2006

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Both address the functional safety of machinery control systems

AS/NZS 4024:1503

- Can the system be designed simply using the designated architectures?
- Will the system include technologies other than electrical? e.g. Hydraulics, Pneumatics

IF the answer to either question is YES
THEN select **AS/NZS 4024:1503**

AS 62061:2006

- Are there complex safety functions e.g. depending on complex logic decisions?
- Will the system require validation to SIL? e.g. Safety PLC, Safety PAC

IF the answer to either question is YES
THEN select AS **62061:2006**

You can choose the most suitable standard for your use

- Two Methods to Achieve the Same Goal of Risk Reduction
- AS/NZS AS4024 is the usual choice

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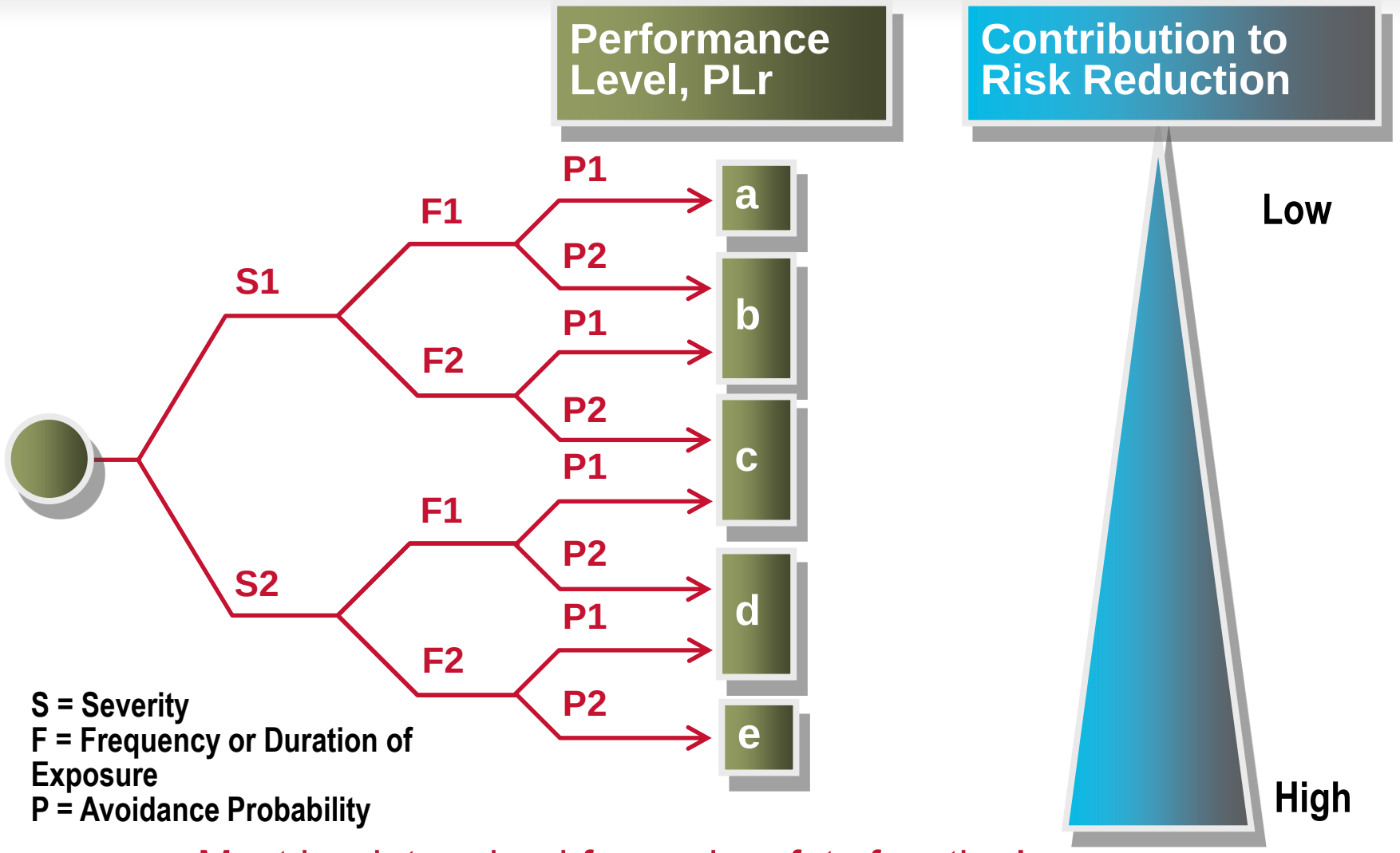
Risk Graph – AS/NZS 4024:1503



Must be determined for each safety function!

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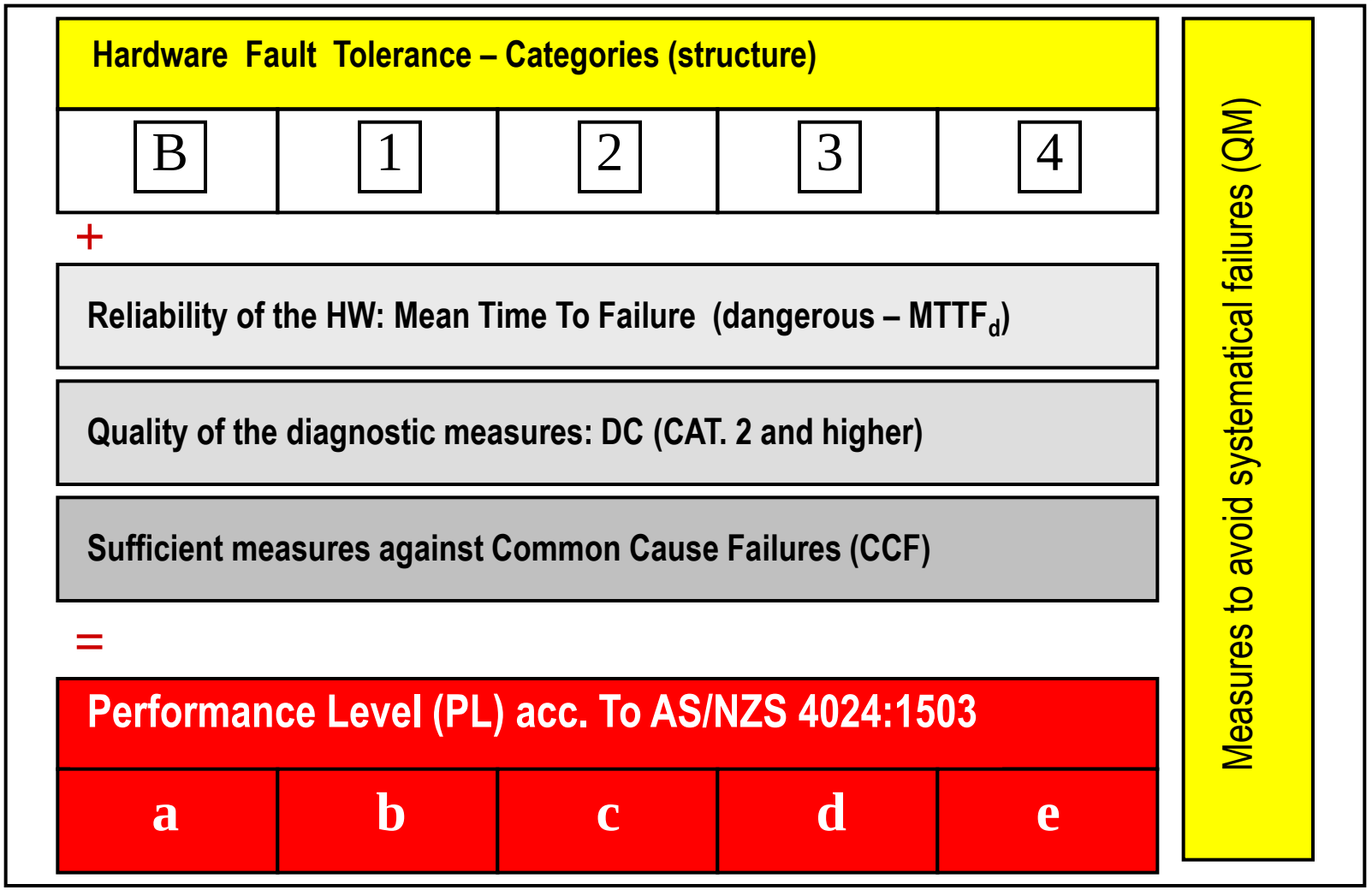
What are Performance Level PL?



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System Requirements – Old vs. New

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AS4024:1501

AS/NZS 4024:1503

Category	Summary of requirements	System behaviour	Principle used to achieve safety
B (see 6.2.3)	SRP/CS and/or their protective equipment, as well as their components, shall be designed, constructed, selected, assembled and combined in accordance with relevant standards so that they can withstand the expected influence. Basic safety principles shall be used.	The occurrence of a fault can lead to the loss of the safety function.	Mainly characterized by selection of components
1 (see 6.2.4)	Requirements of B shall apply. Well-tried components and well-tried safety principles shall be used.	The occurrence of a fault can lead to the loss of the safety function but the probability of occurrence is lower than for category B.	Mainly characterized by selection of components
2 (see 6.2.5)	Requirements of B and the use of well-tried safety principles shall apply. Safety function shall be checked at suitable intervals by the machine control system.	The occurrence of a fault can lead to the loss of the safety function between the checks. The loss of safety function is detected by the check.	Mainly characterized by structure

Requirements

– Functional Safety standards bring additional requirements

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System Requirements – Old vs. New

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AS 4024:1501

AS/NZS 4024:1503

Category	Summary of requirements	System behaviour	Principle used to achieve safety
3 (see 6.2.6)	Requirements of B and the use of well-tried safety principles shall apply. Safety-related parts shall be designed, so that — a single fault in any of these parts does not lead to the loss of the safety function, and — whenever reasonably practicable, the single fault is detected.	When a single fault occurs, the safety function is always performed. Some, but not all, faults will be detected. Accumulation of undetected faults can lead to the loss of the safety function.	Mainly characterized by structure
4 (see 6.2.7)	Requirements of B and the use of well-tried safety principles shall apply. Safety-related parts shall be designed, so that — a single fault in any of these parts does not lead to a loss of the safety function, and — the single fault is detected at or before the next demand upon the safety function, but that if this detection is not possible, an accumulation of undetected faults shall not lead to the loss of the safety function.	When a single fault occurs the safety function is always performed. Detection of accumulated faults reduces the probability of the loss of the safety function (high DC). The faults will be detected in time to prevent the loss of the safety function.	Mainly characterized by structure

Requirements

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The New, Additional Requirements

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MTTFd Mean Time to Dangerous Failure

Low	3 -10 Years
Medium	10-30 Years
High	30-100 Years

$$MTTF_d = \frac{2}{3}\left[MTTF_{dC1} + MTTF_{dC2} - \frac{1}{\frac{1}{MTTF_{dC1}} + \frac{1}{MTTF_{dC2}}}\right]$$

DC Diagnostic Coverage Ratio of Detected Dangerous Failures/ All Dangerous Failures

None	DC < 60%
Low	60 < DC < 90%
Medium	90 < DC < 99%
High	DC >99%

$$DC_{avg} = \frac{\frac{DC_1}{MTTF_{d1}} + \frac{DC_2}{MTTF_{d2}} + \ldots + \frac{DC_N}{MTTF_{dN}}}{\frac{1}{MTTF_{d1}} + \frac{1}{MTTF_{d2}} + \ldots + \frac{1}{MTTF_{dN}}}$$

CCF Common Cause Failure → Two or more separate faults having a common cause shall be considered as a single fault.

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Relationship between PL and SIL

Performance level (PL)	Average probability of a dangerous failure per hour [1/h]	Safety Integrity Level (SIL)
a	$\geq 10^{-5}$ to $< 10^{-4}$	No special safety requirements
b	$\geq 3 \times 10^{-6}$ to $< 10^{-5}$	1
c	$\geq 10^{-6}$ to $< 3 \times 10^{-6}$	1
d	$\geq 10^{-7}$ to $< 10^{-6}$	2
e	$\geq 10^{-8}$ to $< 10^{-7}$	3

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Calculations for Electro-Mechanical Components

- B_{10d} = Number of cycles until a component fails dangerously
- d_{op} = Number of days per year when the machine is operational
- h_{op} = Number of hours per day the machine is operational
- t_{cycle} = Mean time in seconds between the beginning of two consecutive cycles of the component
- To be determined:
  - Number of switching cycles per year:
  - Operation time of the component until it fails dangerously:
  - Mean time to dangerous failure ($MTTF_d$):

$$n_{op} = \frac{d_{op} \times h_{op} \times 3600 s/h}{t_{cycle}}$$

$$T_{10d} = \frac{B_{10d}}{n_{op}}$$

$$MTTF_d = \frac{T_{10d}}{0.1}$$

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Two Types of Failure Data

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- Mechanical or Electromechanical
  - Failure is dependent on load and operating frequency
  - $B10_d$
    - Number of operations where 10% of the sample has failed to danger.
- Electronic
  - Failure is dependent on temperature and time.
  - $MTTF_d$ or PFH_d
    - Mean time to failure - dangerous
      - Probability of dangerous failure per year
    - $MTTF_d \approx 1 / PFH_d$ (must convert years to hours)

- Need to convert these to one data type to complete the analysis.
  - We convert $B10_d$ to $MTTF_d$.

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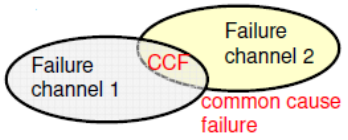
Common Cause (CCF) Failure (β-factor)

- Common Cause Failures (CCF) result from a single cause and affect more than one channel.
- One part of the failures in both channels reveals as CC failures; that means due to one cause a failure in one channel is followed by the same failure in the other channel, either at the same time or some time later.
- Common causes are:
  - **External stress** as excessive temperature, high e/m-interferences, e.g. Wireless devices, motorized devices
  - **Systematic design failures** due to the high complexity of the product or missing experience with the new technology
  - **No spatial separation between channels**, use of common cables, on one PCB, etc.
  - **Human errors** during maintenance and repair



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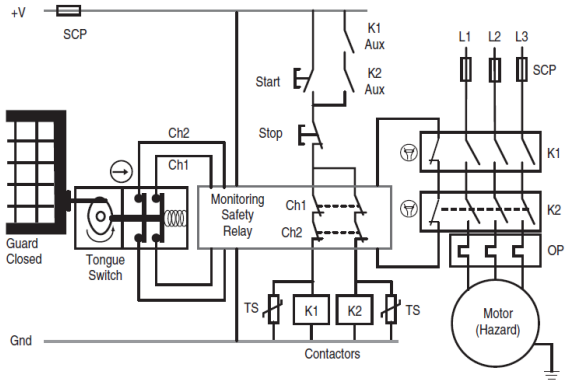
What Is Functional Safety?

- Functional Safety (FS) of machinery are those parts of the machine control system that ensures the safety of personnel and machinery.
- An example of Functional Safety is a simple interlock circuit.



The **Safety Function** could be described as follows:

- *The Safety Gate is opened, the relay detects the SensaGuard outputs going low and de-energises the contactors thus stopping the associated motor.*

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Evolution of Safety Systems

1960 | 1970 | 1980 | 1990 | 2000 | 2010 | Future

Legacy
- High Productivity
- Low Safety
- No Assessment

Initial Safety
- Lower Productivity
- Medium to High Safety
- Hazard Assessment

Modern Safety
- High Productivity
- High Safety
- Risk Assessment

You invest in a ***safety system*** to protect people.
You invest in ***advanced safety technology*** to enhance machine performance.

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Solving the Problem

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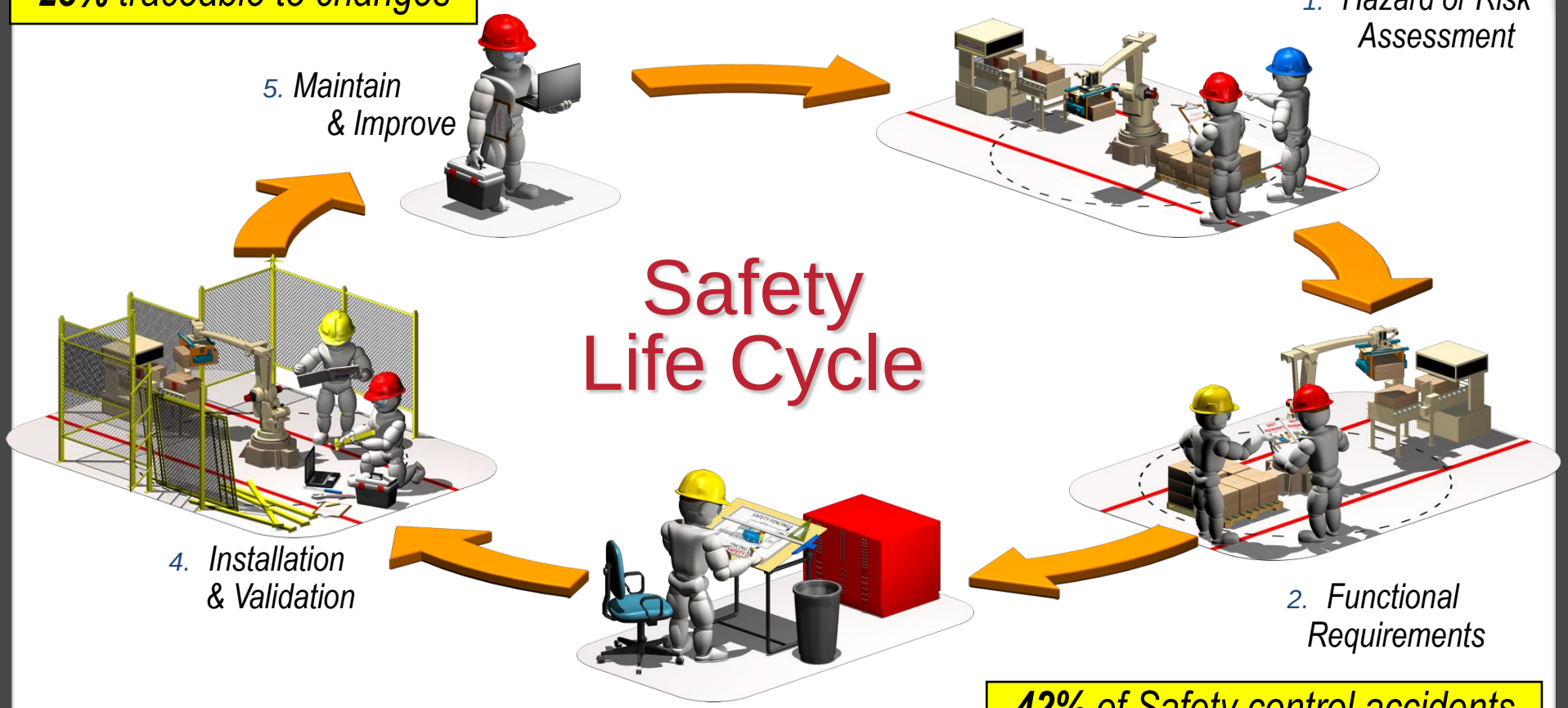
28% *traceable to changes*



42% *of Safety control accidents traceable to design & spec stage*

System design based on integrating safety & machine functionality.

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Modern Safety Thinking

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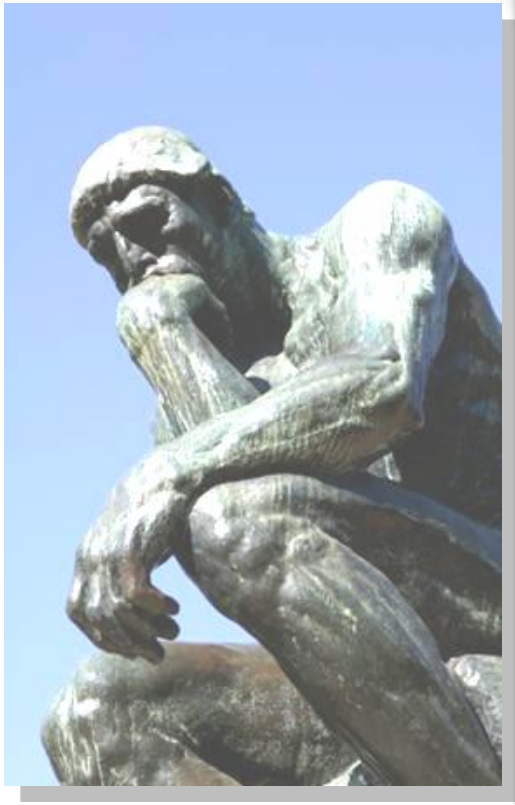
- It's a **Culture**; It's a **Process**; It's a design **Philosophy**
  - It is a combination of people, systems, technologies and work habits
- It is a **systematic approach – Not a component** approach!!!
- For Machine and Process Safety — it is a **lifecycle**
  - From System Concept, through Risk Assessment, Verification & Design, Install, Commissioning & Validation, Operations and Decommissioning



Safety Specifications Drive the Safety Lifecycle

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RA Safety Services – TÜV Functional Safety Training

- Authorised TÜV Functional Safety Course Provider
- TÜV 1 Functional Safety Introduction
  - The new standards regarding Functional Safety and relevant law and directives demand that people and organisations performing responsible (accountable) tasks during all life phases of a machine have to achieve and prove the required competencies. In this training, an introduction to the defined requirements regarding the design and the proof of Functional Safety of machines, in respect to the current standards and guidelines, are described and discussed in detail.
- TÜV 2 Functional Safety (FS Engineer Certification)
  - The 4 .5 days are classroom instructions that provides detailed information and examples / discussions for understanding and mastering the requirements of IEC 62061, ISO 12100, ISO 13849-1 & 2, IEC 60204, and other relevant machine functional safety standards.
  - There is an optional TÜV Functional Safety Certification examination, scheduled on the Friday morning following this course. This optional exam must be passed to receive the TÜV Functional Safety Engineer certification. The training can also be attended without taking the exam.

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RA Safety Services – TÜV Functional Safety Training

- TÜV 3 Functional Safety (FS Technician Certification) – NEW for 2014
  - The 3 days are classroom instructions that provides detailed information and examples / discussions for the understanding and mastering the requirements of IEC 62061, ISO 12100, ISO 13849-1 & 2, IEC 60204, and other relevant machine functional safety standards.
  - There is an optional TÜV Functional Safety Certification examination, scheduled on the last day morning following this course. This optional exam must be passed to receive the TÜV Functional Safety Technician Certificate. The training can also be attended without taking the exam.

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The Value of RA Machine Safety Services

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- Help customers comply with current and emerging standards by providing Consulting Services for safety critical controls
- Our solutions can help customers:
  - Reduce lost-time accidents
  - Enhance work-place Safety
  - Reduce unplanned downtime
  - Improve employee morale
- These solutions ultimately deliver **enhanced productivity**

Global Support. Local Address. Peace of Mind.

Specific Services in the Safety Life Cycle

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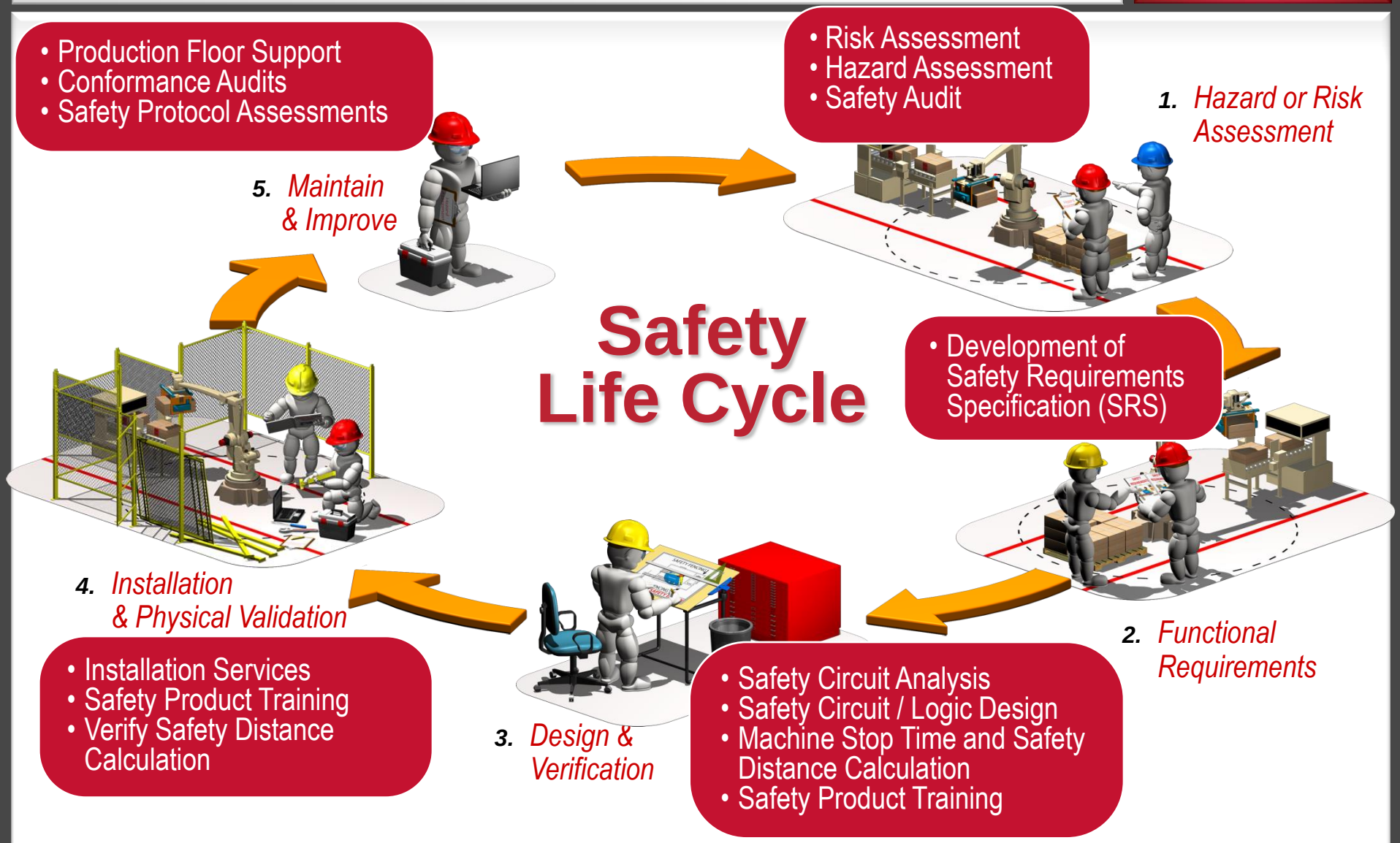
• Risk Assessment
• Hazard Assessment
• Safety Audit
1. Hazard or Risk Assessment
• Development of Safety Requirements Specification (SRS)
2. Functional Requirements
• Safety Circuit Analysis
• Safety Circuit / Logic Design
• Machine Stop Time and Safety Distance Calculation
• Safety Product Training
3. Design & Verification
• Installation Services
• Safety Product Training
• Verify Safety Distance Calculation
4. Installation & Physical Validation
• Production Floor Support
• Conformance Audits
• Safety Protocol Assessments
5. Maintain & Improve
Safety Life Cycle

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RA Safety Services – Machine Safety Seminar

- One day on-site / off -site training program
- The starting point for Machine Safety. Topics include:
  - Risk Assessment process training
  - Machine guarding requirements
  - Safety circuit architectures
  - Presence sensing safety device applications
  - Standards and their application.

Why would you want a Machine Safety Seminar?

- Looking for a starting point on the implementation of modern machine safety techniques

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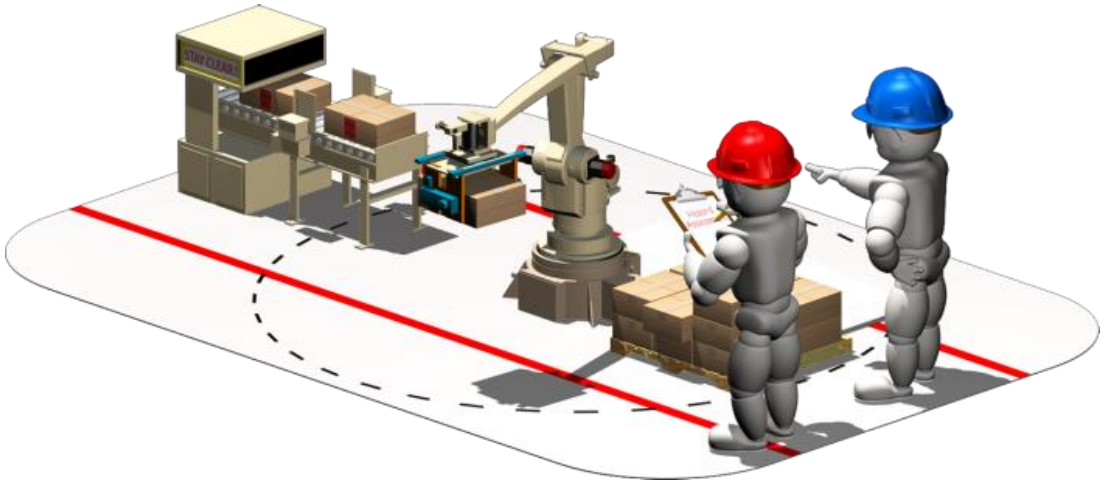
Safety Assessments

- Rockwell Automation Machine Safety Services include the following Safety Assessments:
  - Team-based risk assessments
  - Safety audits
  - Hazard assessments



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Rockwell Automation has scalable assessment solutions to meet customers need!

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Conformity Audits	Hazard / Guarding Assessment	Safety Assessment / Audit	Team-Based Risk Assessment
Modular Assessments	**Identifies Primary Hazards**	**Assessment & Estimate**	**Detailed Risk Assessment**
Provides a scalable solution to help save $	*Identifies guarding/ hazards for immediate plant actions*	***Most common** – provides report & estimates to develop safety plans*	*In-depth analysis required for critical or special machines*
For Multiple machines • Provides customers with a method of categorizing & prioritizing machines • Conformity audits that analyse guarding, LOTO, e-stops and circuit analysis and provides a list of complying & non-complying machines to be assessed.	• One Page Report identifying hazards and "Risk-in" rating only • Does not include: ○ Risk Out rating ○ Cost estimation ○ Pictures	• Assessment led by RA Consultant, limited customer involvement • Report per standard ✓ Identification of primary hazards/tasks ✓ List non-compliance issues ✓ Risk In / Risk Out Rating ✓ Mitigation Guarding and Controls recommendations ✓ Prioritized recommendations for safety improvements ✓ Photograph of critical identified hazards (based on customer approval) ✓ Cost estimate per machine	• Team-based assessment led by RA Consultant for all machine life phases • Report per standards ✓ Identification of primary hazards/tasks ✓ List non-compliance issues ✓ Risk In / Risk Out Rating ✓ Mitigation Guarding and Controls recommendations ✓ Prioritized recommendations for safety improvements ✓ Photograph of critical identified hazards (based on customer approval) ✓ Cost estimate per machine • Mitigation Drawing • Includes ergonomics review (slip, trip, and fall hazards)

A Conformity Audit is a new assessment that is scalable and can help save time & money!

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Conformity Audit – Sample Audit Report

Conformity Audit Results

- A listing of machines with compliance status that can be used to prioritise next steps.

Example Conformity Audit Report

Conformity Audit Checklist

	Guarding							Lock-out & Tag-out				Emergency Stops			Circuit Analysis				
	Existing	Type	Reach Over/Under	Penetration/Safe Dist.	Movable Guard	Interlocked	Un-guarded Hazards	Electrical	Pneumatic	Hydraulic	Other Energy sources	Location	Style	Qty.	Cat	PL	Modes of Interaction	Action Type	Notes
																			Note area that can be used to identify duplicate machines and any urgent issues

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RA Safety Services – Safety Circuit Analysis

- RA Safety Consultant will review the machine safety circuit supplied by the customer for compliance to the safety circuit performance level specified by the customer
- If the circuit is not found to be in compliance, the corresponding areas of the drawing will be “red-lined” with notations that reference back to the standard showing the deficiency of the design
- A short written report will be provided documenting the findings

Why would you want a Safety Circuit Analysis?

- To get a third party opinion that a safety circuit design conforms to the appropriate standards
- Especially appropriate for customers with less safety design experience

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RA Safety Services – Machine Stop Time Measurements

- RA Safety Consultant will perform a physical measurement to determine the stop time of the machinery
  - How long does it take the machine to reach a safe state?

Why would you want a Stop Time Measurement?

- The stop time is used to determine what type of safeguarding techniques can be used as well as the appropriate mounting position
  - For example, how far away from the hazard does a light curtain need to be mounted in order to give the machine enough time to stop after the light curtain determines that something is approaching the hazard
- Machine Stop Time is a key component of the safety distance calculation

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Compliance Consulting

- Rockwell Automation Safety Services include the following areas of Compliance Consulting:
  - Compliance audits
    - ISO, ANSI, IEC, CE, OSHA, NFPA, CSA, AS
    - Functional Safety (EN ISO 13849:1 and IEC EN AS 62061)
    - CE Mark Conformance
  - Lockout/Tagout compliance (North America)
  - Conformance audits
  - Safety protocol assessments

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Validation Services

- Rockwell Automation Safety Services include the following Validation Services:
  - Safety system validation and design reviews
  - Safety circuit analysis
  - Machine stop time and safety distance calculations

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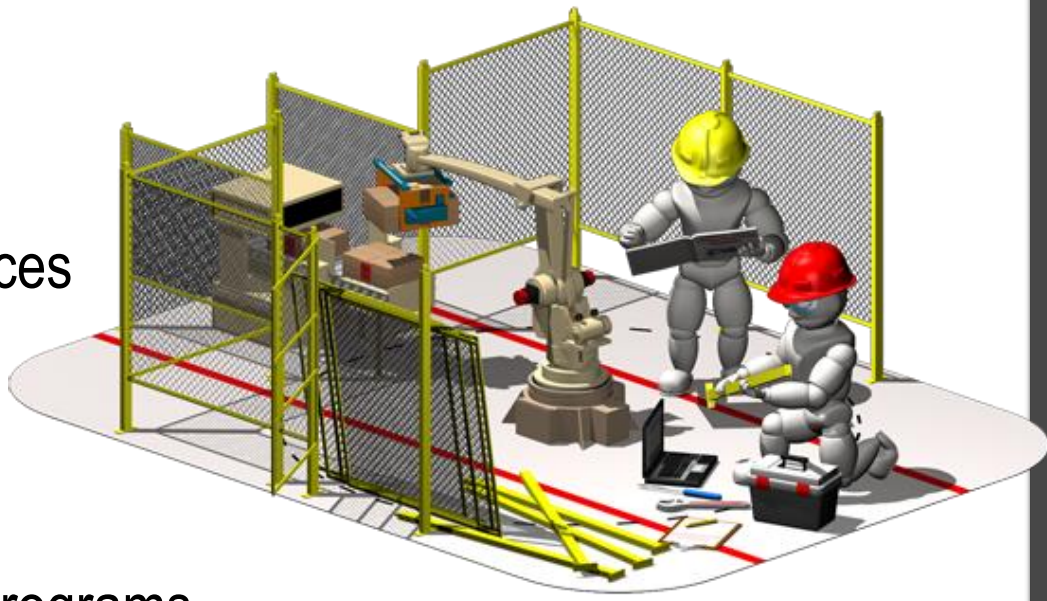
Installation and Production Services

- Rockwell Automation Machine Safety Services include the following Installation and Production Services:
  - Project management
  - Material procurement
    - RA products
    - Third party products (e.g. hard-guarding)
  - Installation / assembly services
  - Start-up assistance
  - Factory acceptance
  - Field support services
  - Preventative maintenance programs
  - Production floor safety system support



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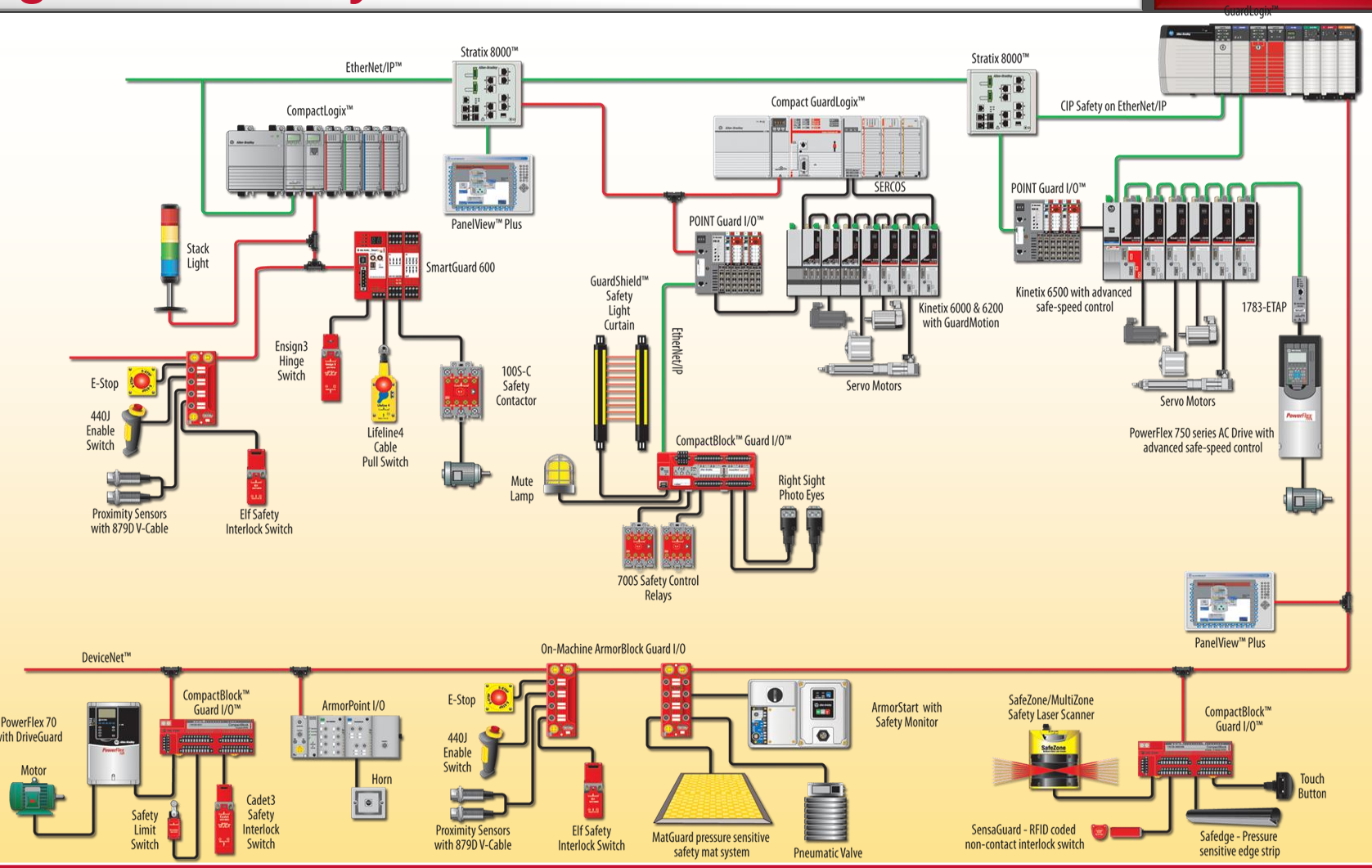
Integrated Safety Architecture

Rockwell Automation



Adds **significant value** throughout the manufacturing process.

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Rockwell Automation Safety Solutions

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Lockout Tagout Essentials

Session Overview

- What is Lockout Tagout?
- Regulatory Responsibilities for Energy Isolation
- Guidelines for Effective Energy Isolation
- Practical Solutions for Energy Isolation

What Is Lockout Tagout?

PURPOSE

To protect workers involved in the maintenance and servicing of equipment from the dangerous effects of hazardous energy.

LOCKOUT

A device such as a lock that physically prevents someone from activating equipment.

Uses a positive means to hold an energy isolating device in the safe position and prevent energisation.

TAGOUT

Placement of a tag on an energy isolating device.

The isolation point visually shows that the energy being controlled and may not be operated until the tagout device is removed.

How does Lock Out Tag Out meet WHS?

- Companies must have a documented risk position when dealing with the three areas within any business:
- Live Electrical Work
- Confined Spaces
- Diving

- Whose responsibility is it to identify and implement Risk reduction Plans?
- Company Officers
- PCBU – for what is reasonably known

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What Is Lockout Tagout?

Complete Lockout

STEP 1

Choose Device and attach to energy source

+

STEP 2

Choose Padlock and attach to device to secure Lockout

+

STEP 3

Choose Tag and attach to padlock for communication

WORKPLACE SAFETY COMPLIANCE SOLUTIONS

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Benefits of Lockout Tagout

- ✓ Provides a safer workplace while doing maintenance, cleaning or repairs
- ✓ Prevents accidents, injuries (LTIs) and fatalities
- ✓ Increases productivity and reduces equipment downtime and damage
- ✓ Makes **Workplace Safety Easy** with the right systems and solutions
- ✓ Lower premiums for self-insured organisations and limits liability

WHEN PERFORMANCE MATTERS MOST™

Increase Safety & Lower Risks with Brady

Customers are focused on *Earning* more revenue.

The value we offer is delivering solutions that protect workers, prevent injuries and help manage workplace safety obligations.

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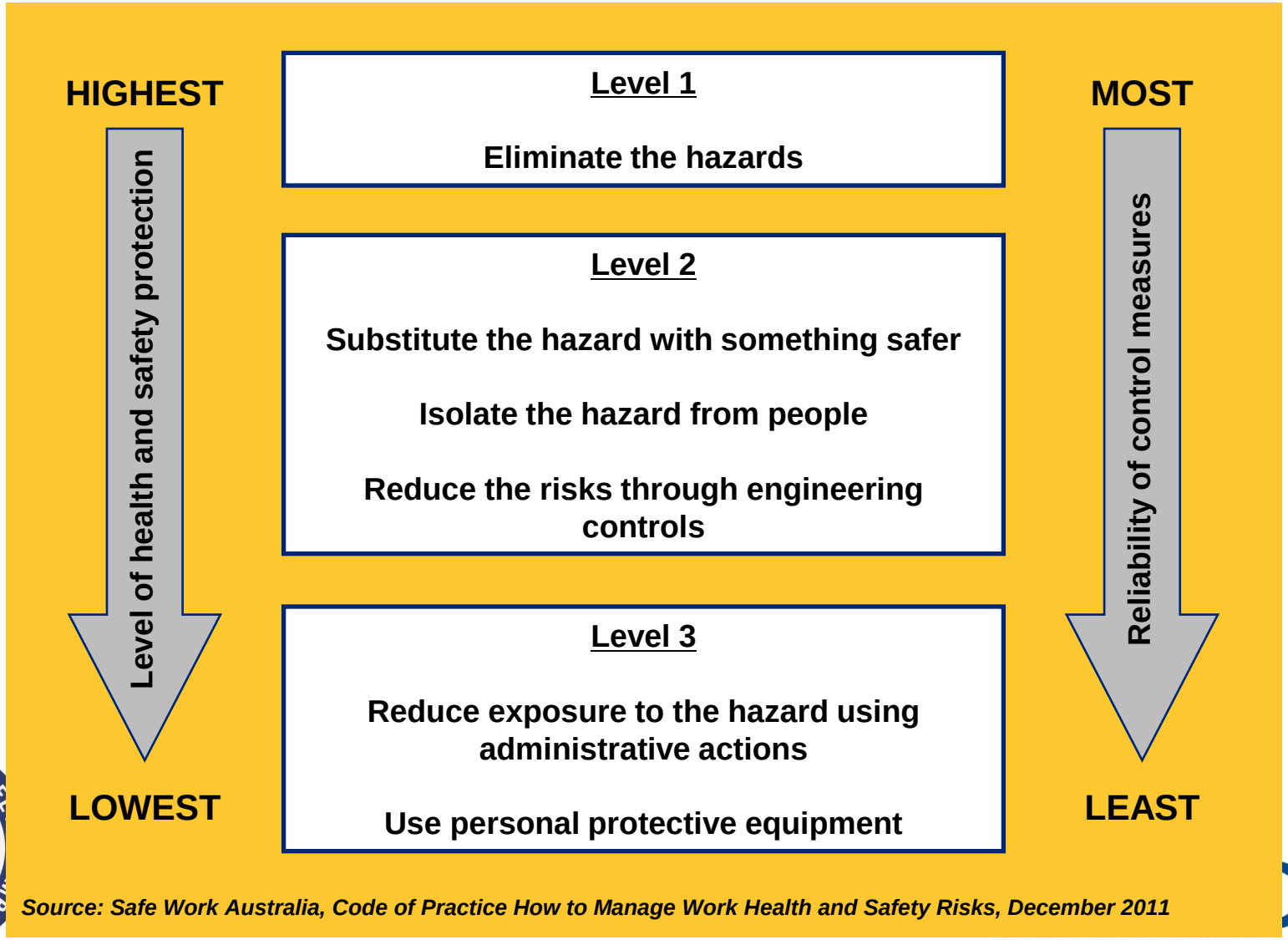
Risk Control Hierarchy



Source: Safe Work Australia, Code of Practice How to Manage Work Health and Safety Risks, December 2011

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When is Lockout Tagout Required?

- Whenever a worker performing service or maintenance may be exposed to any form of *hazardous energy.*

Rule of thumb is to use Lockout Tagout whenever:

- A machine guard must be bypassed.
- A worker must place any part of his body is a danger zone or point of operation.

WORKPLACE SAFETY COMPLIANCE SOLUTIONS

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Lockout Tagout Industry User Groups

Mining

Food & Beverage

Utilities

Healthcare

Manufacturing & Processing

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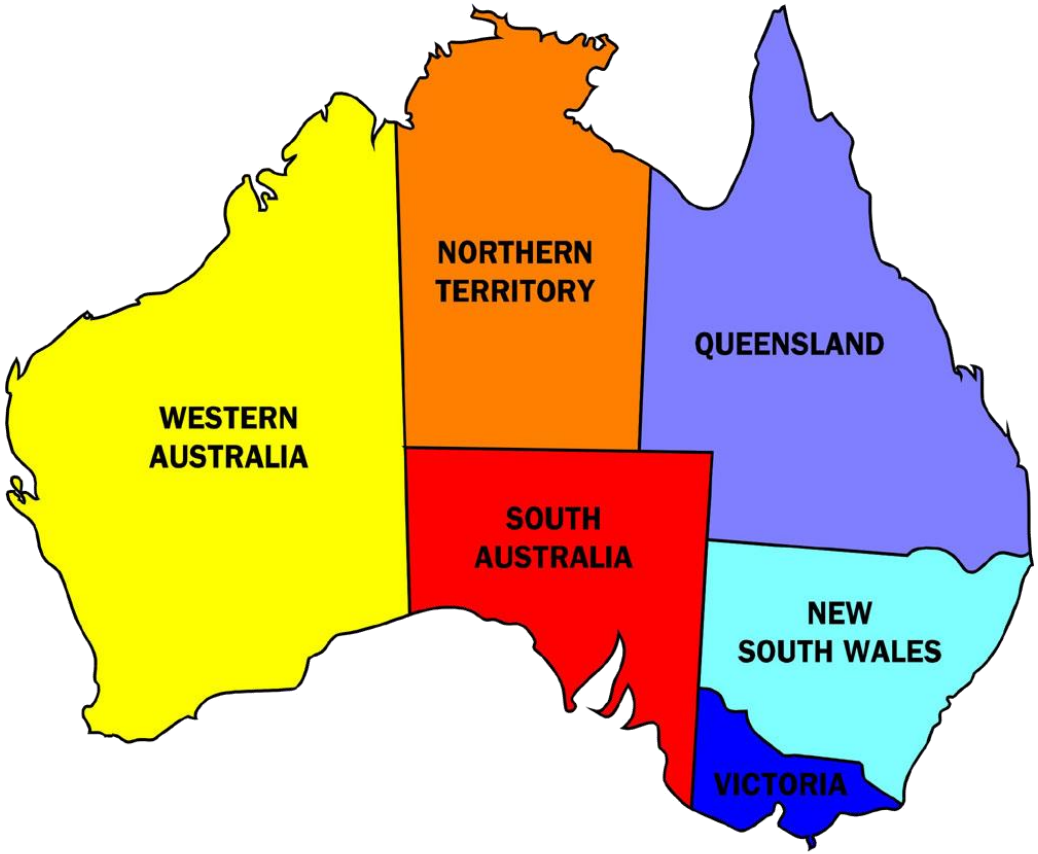
Australian Regulations & Standards

What you need to know and do to be compliant with current regulations.



WORKPLACE SAFETY COMPLIANCE SOLUTIONS

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Australian Regulations & Standards

Jurisdiction	Application	Regulations & Standards
National	Electrical	**AS/NZS 4836:2011** **Safe working on or near low-voltage electrical installations and equipment** ▪ Specifies a minimum set of procedures, safety requirements and recommendations to manage the hazards associated with electricity.
National	Machinery	**AS 4024.1603-2006** **Safety of machinery - Design of controls, interlocks and guards - Prevention of unexpected start-up** ▪ This Standard includes the specific requirement for all isolated energy sources to be locked, to ensure that it is not possible for somebody to inadvertently re-energise equipment that has been isolated.
NSW, ACT, QLD, SA, TAS, NT,	Workplace Safety	**Work Health and Safety Regulations 2011** ▪ Outlines specific requirements pertaining to General Electrical Safety in Workplaces and Energised Electrical Work. A PCBU must ensure electrical work is not carried out while equipment is energised.
Queensland	Mining	**Coal Mining Safety and Health Regulation 2001** **Part 4 Electrical activities, equipment and installations** **Part 10 Plant** ▪ Outlines the requirement for standard operating procedures for safety and controlling risks of unplanned energy release.
New South Wales	Mining	**Electrical Engineering Safety Electrical Isolation** ▪ Provides guidance material for mine operators in the development of electrical safety standards.

Australian Regulations & Standards

Jurisdiction	Application	Regulations & Standards
Victoria	Workplace Safety	**WorkSafe Victoria** **Isolating Plant Guidance Note** ▪ Includes recommended procedures for isolating plant.
South Australia	Workplace Safety	**SafeWork SA** **Plant Isolation Procedures - Lockout, Danger and Out of Service Tags** ▪ Provides guidance to employers and employees on the appropriate isolation procedures for plant undergoing maintenance, cleaning, repair or construction.
Western Australia	Mining	**Department of Industry and Resources WA** **Isolation and Tag-out Procedures Guideline** ▪ The purpose of the guidelines is to describe well established principles from which employers can develop effective isolation policy appropriate to particular minesite conditions.

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Guidelines for Effective Isolation

1. Identify and Isolate Energy Sources
2. Apply Locks and Tags
3. Check Isolation and Energy Controls
4. Work on Equipment
5. Remove Locks and Tags
6. Post Isolation Energy Start Up

Other Considerations

- Communication is important. Tell affected workers about the isolation details.
- Isolation procedures should serve as a checklist that allows workers to move through the steps without confusion.
- Only authorised workers who have completed the appropriate training should undertake the Isolation procedures.

Lockout Tagout Practical Solutions

Padlocks & Tags

Lockout Kits

Group Lockout

Training Tools

Product suggestions to help prevent injuries.

WORKPLACE SAFETY COMPLIANCE SOLUTIONS

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Two Types of Lockout Applications

1. Electrical – to control all types of electrical control points (switches, plugs etc.)

2. Valve – to lockout all types of valves
   (Steam pipe, boiler rooms, plumbing etc.)

Electrical

Valve

WORKPLACE SAFETY COMPLIANCE SOLUTIONS

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Lockout Tagout Essentials Summary

- The purpose of Lockout Tagout is to protect workers from the dangerous effects of hazardous energy.
- Brady makes **Workplace Safety Easy** by helping customers manage their workplace safety obligations.
- Use the Regulations & Standards reference to be familiar with the operational benchmark your customer is working towards.
- An isolation procedure should serve as a checklist approach to facilitate an effective program.

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Questions

Lockout Tagout Product & Application.

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Arc Flash- Dynamics,Standards, Field Installations and Safety Plan

Presentation by David Cassidy

Agenda

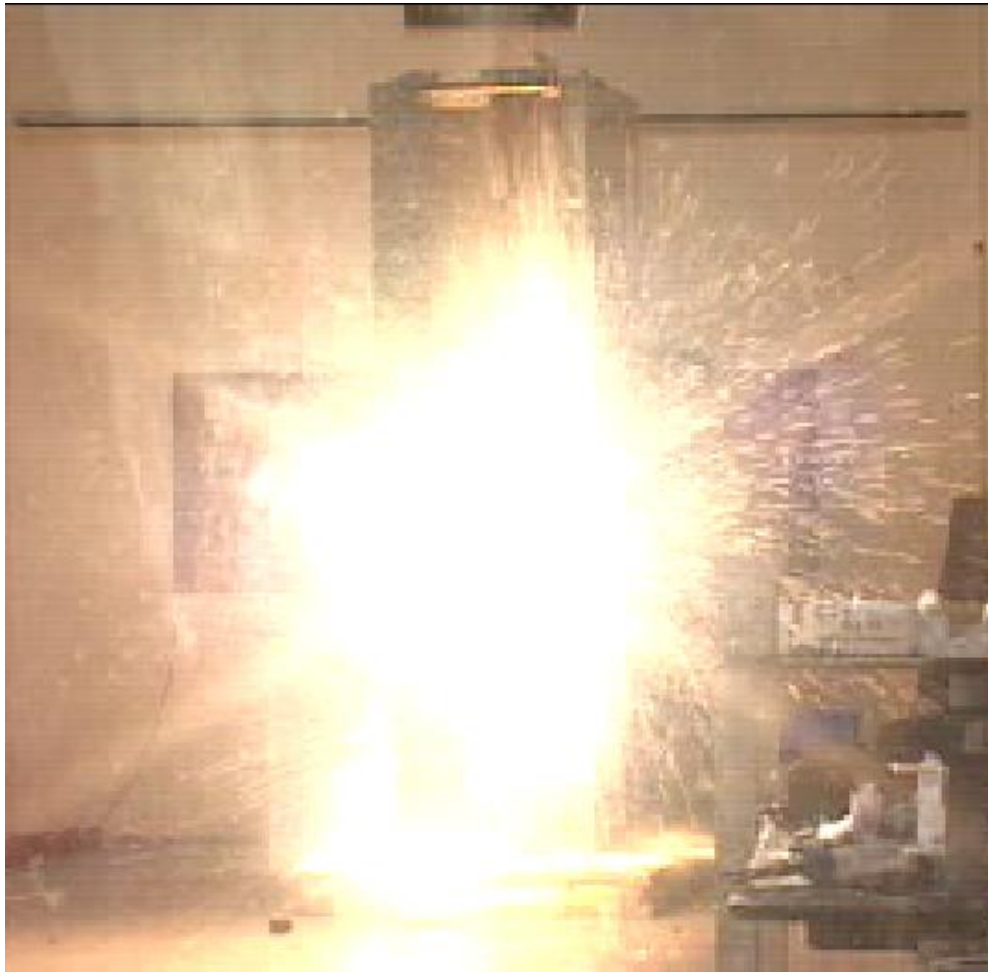
1. Arc Flash Dynamics /Characteristics

2. Arc Flash Related Standards

3. Field Installations of Arc Flash Contain Equipment

4. Safety Plan & Mitigation of Arc Flash Hazards

Arc Flash Dynamics



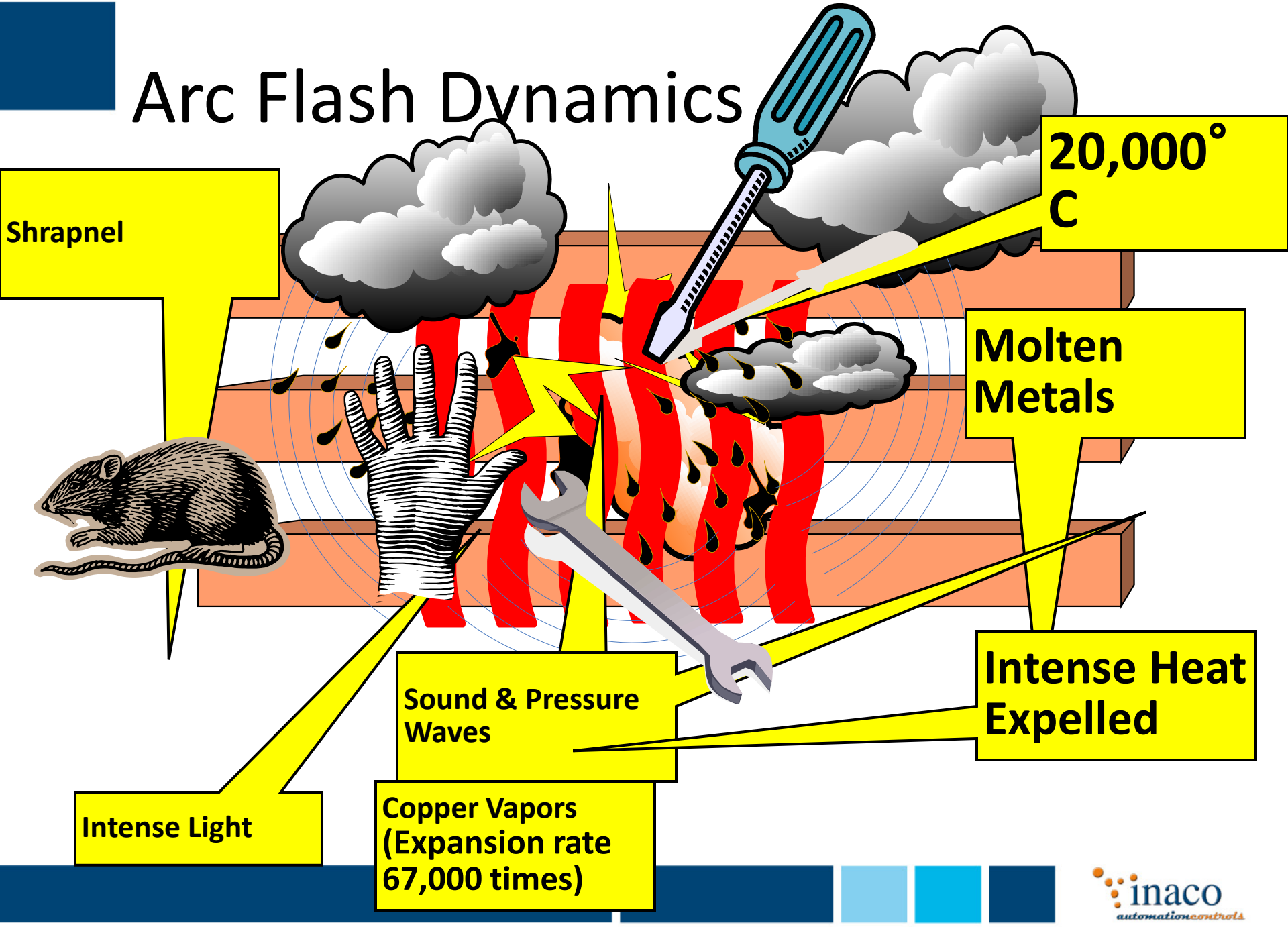
So what is an Arc Flash?

Simply....

*"An arc flash is a short circuit through the **air."***

In many instances, the arc is initiated by the actions of a person!

Arc Flash Dynamics



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Figures are Frightening!

- Arc temperatures can reach up to ~20,000ºC (4 times the temperature on sun's surface!)
- Pressure Waves can snap the heads off 10mm bolts (and burst ear drums!)
- Sound pressure levels greater than 140dB- louder then a jet!
- Metal shrapnel flying @ 1,100 km per hour
- A 10,000 Amp arc blast at 480 volts is equivalent to approx. 8 sticks of dynamite.
- Clothing can be ignited several meters away

Bolted Fault vs. Arc Fault

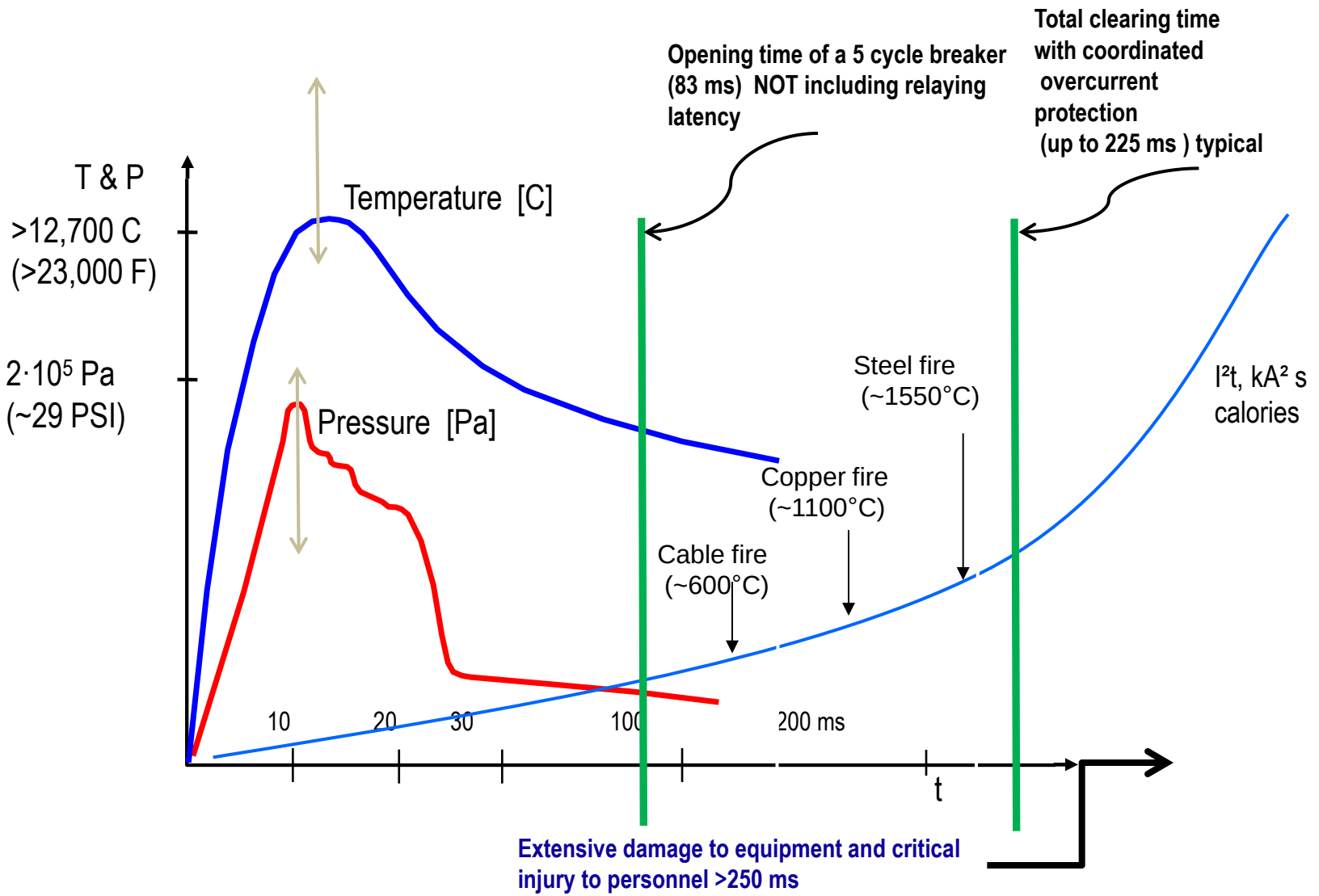
Bolted faults

- Low impedance and high current
- Energy is contained by the conductor (bus or cable)
- Cleared quickly by circuit breakers or fuses (Inst)
- Arcing is confined within the circuit breaker or fuse
- Relatively low safety risk to personnel

Arcing faults

- High impedance (air) results in lower current
- Energy released into surrounding air
- Persist longer (Inv Time)
- Propagate along bus
- High release of heat and blast energy
- Are very destructive and dangerous to personnel

Typical Arc Pressure & Temperature Profile



Agenda

1. Arc Flash Characteristics / Dynamics
2. Arc Flash Related Standards
3. Field Installations of Arc Flash Contain Equipment
4. Safety Plan & Mitigation of Arc Flash Hazards

Australian Standards for ARC Flash

Si

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Who We Are | What We Do | Our Mission, Values and Vision | Corporate Governance | Leadership | Investor Relations | Corporate News | Careers

Search Results

Search Results

Buy Standards & Technical Information about ARC flash

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Arc Flash Standards

- No Australian Standard currently exists for Calculation Method
- AS/NZS 4836:2011 - *Safe working on or near low-voltage electrical installations and equipment*
- ENA NENS – 09 - Selection and use of PPE for Arc flash hazard
- AS 3439 Series : Internal Arc fault containment
- IEEE 1584.1:2013 Series – *Guide for Performing Arc Flash Hazard Calculations*
- NFPA 70E - 2012 Edition – *Standard for Electrical Safety in the Workplace*

But First… Terminology

- ***"Arc Flash Incident Energy"***

– The amount of energy a surface (or person) is exposed to at a set distance from an arc, typically the working distance. Units used are ***cal/cm2***

- ***"Arc Flash Approach Boundary"***

– An approach distance for a given Incident Energy where if entered could result in second degree burns. (i.e. above 1.2 cal/cm2)

- ***"Arc Flash Hazard Category"***

– A number (from 0 to 4) that aligns with an Incident Energy rating and identifies a corresponding level of PPE

Hazard/Risk Category	Protective Clothing and PPE
0	Protective clothing, non-melting, or untreated natural fiber (e.g., untreated cotton, wool, rayon, or silk, or a blend of these materials) with a fabric weight of at least 4.5 oz/yd^2 Shirt (long sleeve) Pants (long) **Protective Equipment** Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy duty leather gloves (AN) (See Note 1)
1	**Arc-rated Clothing, Minimum Arc-rating of 4 cal/cm^2 (See Note 3)** Arc-rated long sleeve shirt and pants or arc-rated coverall Arc-rated face shield (See Note 2) or arc flash suit hood Arc-rated jacket, parka, rainwear, or hard hat liner (AN) **Protective Equipment** Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy duty leather gloves (See Note 1)
2	**Arc-rated Clothing, Minimum Arc Rating of 8 cal/cm^2 (See Note 3)** Arc-rated long sleeve shirt and pants or arc rated coverall Arc-rated flash suit hood or arc-rated face shield (See Note 2) and arc-rated balaclava Arc-rated jacket, parka, rainwear, or hard hat liner (AN) **Protective Equipment** Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy-duty leather gloves (See Note 1) Leather work shoes
3	**Arc-rated Clothing Selected so that the System Arc Rating Meets the Required Minimum Arc-rating of 25 cal/cm^2 (See Note 3)** Arc-rated long sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood (AR) Arc-rated gloves (See Note 1) Arc-rated jacket, parka, rainwear, or hard hat liner (AN) **Protective Equipment** Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather work shoes

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4	**Arc-rated Clothing selected so that the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm^2** Arc-rated long sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood (AR) Arc-rated gloves (See Note 1) Arc-rated jacket, parka, rainwear, or hard hat liner (AN) **Protective Equipment** Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather work shoes

AS/NZS 4836:2011

- Safe working on or near LV installations

– Revised in May 2011 to include Arc Flash Safety
– Emphasises Risk Assessment & Risk Management
– Lists suitable Safety Equipment and Tools.
– PPE is not first line of defence, but to be used as a precautionary measure
– Does not utilise Incident Energies to select HRC & PPE

AS/NZS 4836:2011

TABLE 9.2 GUIDE TO THE SELECTION OF PERSONAL PROTECTIVE EQUIPMENT

TASK	CURRENTS UP TO AND INCLUDING 100 A	CURRENT EXCEEDING 100 A AND UP TO AND INCLUDING 400 A	CURRENTS EXCEEDING 400 A
Work (isolated and verified)	Footwear Protective clothing (if required) Eye protection (if required) Gloves (if required) Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)	Footwear Protective clothing (if required) Eye protection (if required) Gloves (if required) Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)	Footwear Protective clothing (if required) Eye protection (if required) Gloves (if required) Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)
Switching, isolating, removing fuses or links	Footwear Protective clothing Eye protection Gloves (if required) Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)	Footwear Protective clothing Eye protection Gloves Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)	Footwear Protective clothing Eye protection Gloves Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)
Isolation verification, testing or fault finding	Footwear Protective clothing Eye protection Gloves Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)	Footwear Protective clothing* Eye protection Gloves Arc flash suit and hood (if required) Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required) Face shield (if required)	Footwear Protective clothing* Eye protection Gloves Face shield Arc flash suit and hood (if required) Hearing protection (if required) Safety helmet (if required) Respiratory protection (if required)
Live electrical work	Footwear Protective clothing* Eye protection Insulating gloves Arc flash suit and hood (if required) Flame-resistant gloves (if required) Face shield (if required) Safety helmet (if required) Hearing protection (if required) Respiratory protection (if required)	Footwear Protective clothing * Eye protection Safety helmet Insulating gloves Arc flash suit and hood (if required) Flame-resistant gloves (if required) Face shield (if required) Hearing protection (if required) Respiratory protection (if required)	Footwear Protective clothing * Eye protection Insulating gloves Flame-resistant gloves Arc flash suit and hood Hearing protection Respiratory protection (if required)

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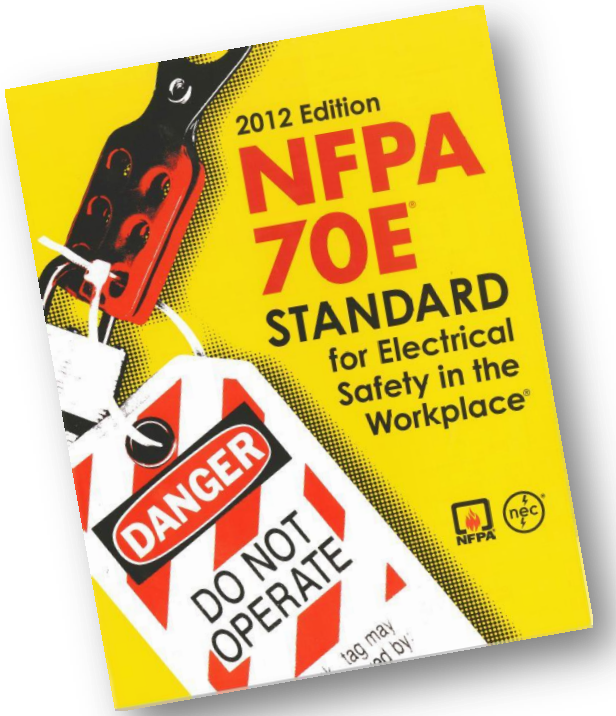
Electrical Safety Standards – NFPA 70E (USA)

NFPA 70E, the Standard for Electrical Safety in the Workplace – 2012

- Electrical Safety, including Arc Flash Hazards, are a focus of all users
- Intended to help protect employees from electrical hazards
- Users are looking for more safety-related features to be integrated into equipment
- NFPA-70E is not a direct design standard for the installation, modification or construction of electrical systems



Increasing focus on electrical safety and safety programs!

IEEE 1584 - 2002

- Provides most accepted method for calculating Incident Energy and Flash Protection Boundary
- Equations are based on extensive practical experiments
- Applies up to 15kV, 106KA
- Background physics now being challenged

Agenda

1. Arc Flash Characteristics / Dynamics
2. Arc Flash Related Standards
3. Field Installations of Arc Flash Contain Equipment
4. Safety Plan & Mitigation of Arc Flash Hazards

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Arc Resistant Equipment

- ***Arc Resistant*** is a term used to describe how a piece of equipment resists the effects of an internal arc fault (relates to arc flash exposure)
- The level of arc flash protection is defined by the level to which an arc flash/blast is:
  - Extinguished or Controlled
  - Channeled away from personnel
  - Prevented from propagating
- Testing must be performed to validate a level of resistance (protection)
  - Defined as the "**Arc Resistant Accessibility Rating"**
- The **equipment manufacturer** is responsible to test to a given standard or guide to validate a given accessibility rating.

The Accessibility Rating defines one of the performance characteristics for arc resistant equipment….

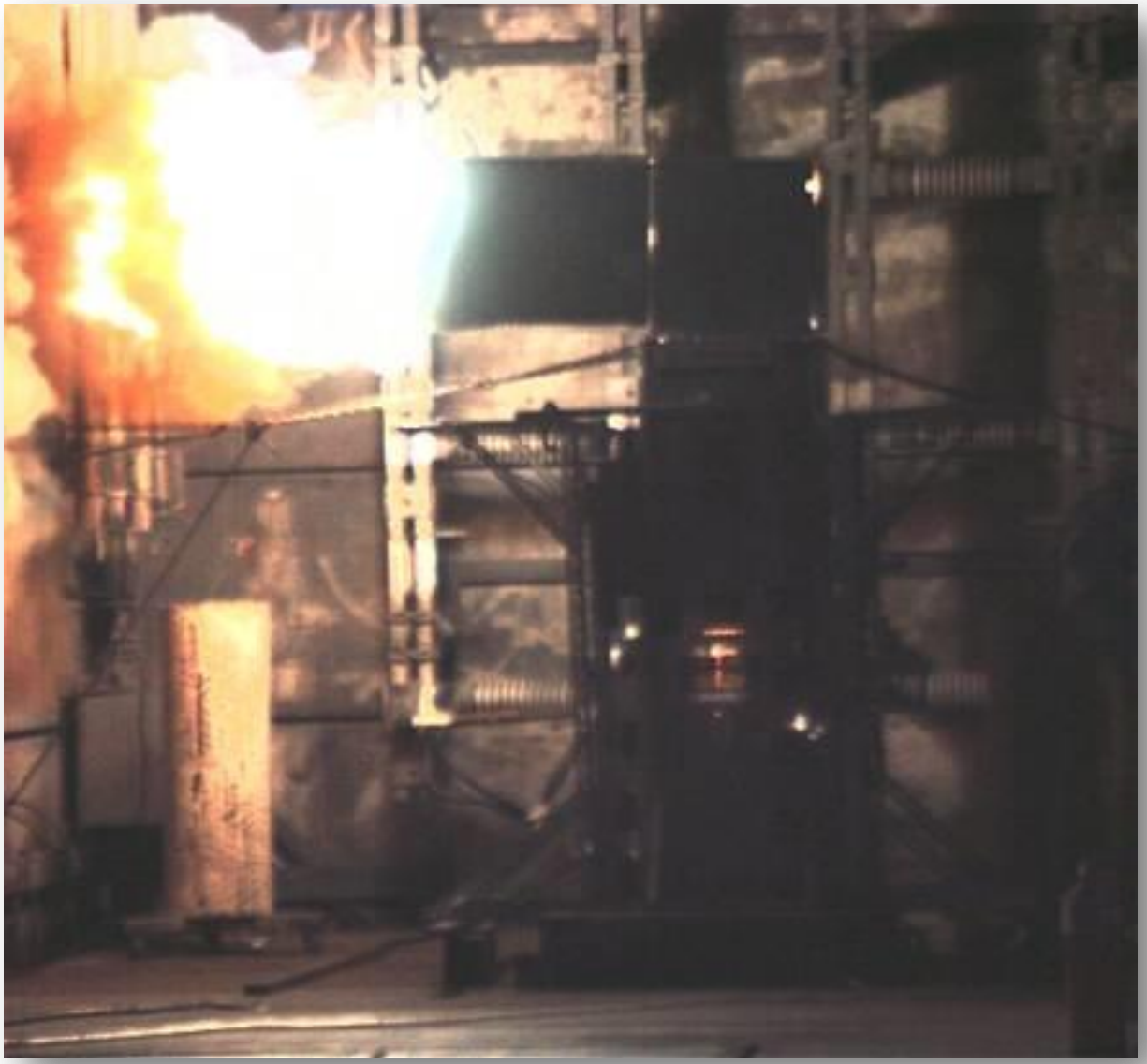
Arc Resistant Equipment Considerations

- Tested to a relevant testing standard
- Letter of Attestation should be available.

- Global arc resistant testing guides and standards include:
  - **AS 3439.1-2002**
  - **IEEE C37.20.7-2007**
  - **IEC 62271-200 (Annex A)**
  - **EEMAC G14-1**
  - **IEC 61641 - 2008**

Typical Test Setup

A Successful Arc Test



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Arc Resistant Equipment Considerations

IEEE C37.20.7-2007 - ***guide for testing metal-enclosed switchgear.***

IEEE
IEEE Guide for Testing Metal-Enclosed Switchgear Rated Up to 38 kV for Internal Arcing Faults
IEEE Power Engineering Society
Sponsored by the Switchgear Committee
C37.20.7

- Scope expanded to include low voltage switchgear
- Defines test criteria and assessment
- Defines Accessibility Level of equipment and outlines the levels of arc flash protection
- Accessibility Level ratings set expectations of equipment arc resistance performance

IEEE C37.20.7-2007 is a recognized industry standard that applies to MV and some LV equipment

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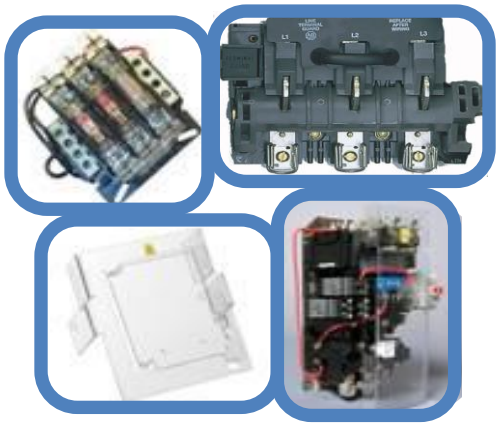
Passing the Test

- Passing* an IEEE C37.20.7-2007 test means:
  - Doors and covers do not open (bowing allowed)
  - No parts are ejected.
  - No holes in the exterior (in the applicable planes for the accessibility level)
  - 150 g/m^2 - Cotton test indicators must not ignited or be perforated, (approximates typical industrial work clothes)
  - The grounding remain effective

***Varies by guide/standard**

Safety Features Available for MCC



Covers and Barriers

Through the Door
Viewing Windows

High Visibility Yellow
Door for Main

Through the Door
Network Connections

Infrared Sightglass for
Thermal Inspection

Door Mounted
Voltage Detection

DeviceNet Programmer
193-DNCT

SafeZone™ Laser
Scanner

Fiber Optic
Arc Detection/Arc
Clamping Systems

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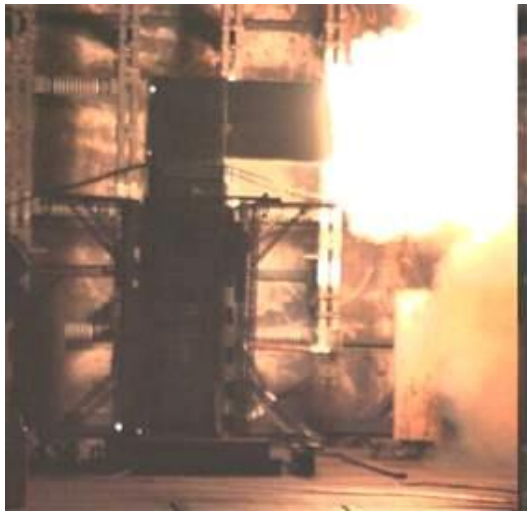
Arc Resistant Equipment Considerations

- Significant deviations to cabinet design may not be possible if arc resistant integrity is to be maintained
  - Some typical options may not be available
  - More Stringent Installation practices
  - Field modifications must be approved by the manufacturer
  - You don't want to compromise the equipment's ability to control an arc flash event

It is critical to maintain the arc resistant capability of arc resistant equipment - as purchased!

Installation Considerations

- Where should the energy from an arc flash be directed?
  - An area inaccessible to personnel and no flammable materials are present
  - Venting - Externally is generally preferred, with a barrier used for weather & vermin protection.



- If the arc gases are released into a control room, it must be designed to withstand:
  - Overpressure, up to 15-20 psi, on a transient basis
  - The effects of hot gases and flames as they are released into the room (i.e. non-flammable construction materials are required)
  - Special ventilation may be required

Agenda

1. Arc Flash Characteristics / Dynamics
2. Arc Flash Related Standards
3. Field Installations of Arc Flash Contain Equipment
4. Safety Plan & Mitigation of Arc Flash Hazards

The Importance of Arc Flash Safety Plan

- Prevent personal injuries
- Prevent potential loss to organisations through,
  - Loss of skilled manpower
  - Litigation fees
  - Higher insurance costs
  - Loss of company morale
  - Production losses

WH&S refers to keeping workers safe around electrical equipment without referencing any specific standard(s)

Safety Plan & Arc Flash Risk Mitigation

- Arc Flash Analysis shall be part of the overall company safety plan-understand what you may not know
- Adequate training and use of PPE shall be mandatory as per the safety procedures and plan.
- Identify and label the hazards, as per risk assessment.
- Use Arc fault resistance switchgears in the plant to minimise risk.

Arc Flash Safety Plan – Actions List

- Use Arc Fault contain equipment.
  - (e.g. Centreline 2500 MCC)
- Install phase indicators.
  - (e.g. voltage vision from Grace port)
- Implement remote controls.
- Replace older protection devices
- Add additional protection devices
- Replace old & dangerous switchboards.

Arc Flash Safety Plan – Actions List

- Training - Establish Skills and Competencies
- Change Control Procedures for Plant Maintenance.
- Standard designs & equipment specification for new equipment
- Regular updates to Arc Flash Studies
- Purchase appropriate PPE

PPE Rating Table		
Incident energy rating in cal/cm^2	Arc Flash Hazard/Risk Category	PPE Category
N/A	0	0
0-4	1	1
>4-8	2	2
>8-25	3	3*
>25-40	4	4
>40	X	N/A
PPE controls are not suitable for incident energies in excess of 40 cal/cm^2. Alternative controls shall be implemented.		

Examples of PPE

PPE – Categories 1

NFPA 70E-2012:
Cat 2 requires
balaclava + face shield

PPE – Categories 3 & 4

ARC FLASH ANALYSIS AND MITIGATION- CUSTOMER APPLICATION

- Arc Flash Analysis report conducted at customer on the Central Coast NSW to provide the onsite inspection, analysis and report creation
- Site inspection for 1 day, further information gathering delivered a comprehensive report.
- Report covered Short Circuit Calculations, Equipment Evaluation, Miss co-ordination of Protective Devices and Arc Flash Analysis
- Once the risks have been identified then actions that can be taken to mitigate the risks
- Mitigation Report-This will present a road map for them to undertake actions to reduce the Arc Flash Hazards by revised protective device settings, additional of new protective devices, implementation of a administrative controls, use of remote switching, etc.

Key Take Away

- Arc resistant equipment offers a higher level of safety to personnel
- Ensure that arc resistant equipment has been tested to relevant standards.
- Avoid modifications to the standard tested designs.
- Arc resistant equipment requires some additional engineering steps to successfully implement
- Arc resistant equipment requires more diligence for proper installation.
- Inaco can help you with Arc Flash Analysis and Mitigation Reports

Arc resistant equipment can be a vital part of a comprehensive program for improving personnel safety

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Integrated Safety Solutions- Safety Controllers & Interfaces, Communication Portals, Voltage Indicators & IR windows

Presentation by David Cassidy

LISTEN. THINK. SOLVE.®

Safety Interfaces

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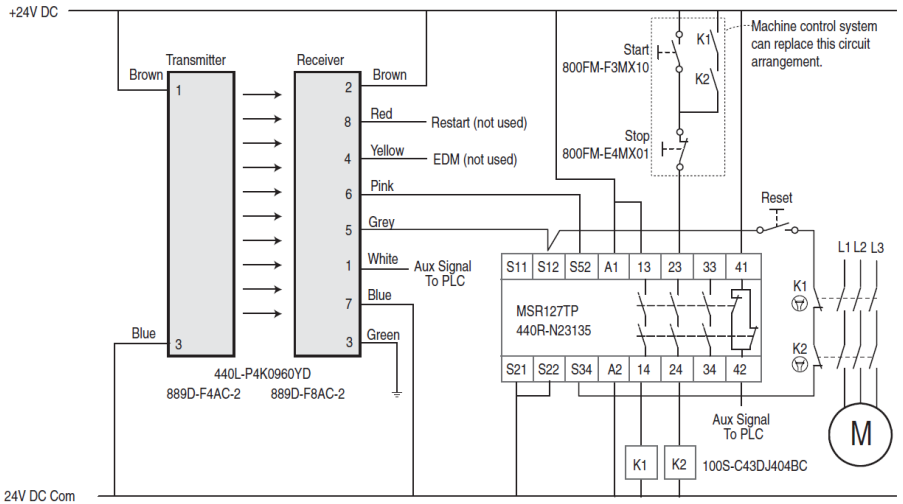
What is a Safety Interface?

- Provides monitoring and logical functions to a safety related control system
- Monitors the operation of safety device i.e. Safety Switch and contactor
- Provides logical functions – resets, timers etc…
- Application specific devices – muting, speed monitoring
- All safety systems Cat 2 (PLc, SIL1) up require some type of monitoring inteface (Relay, Controller, PLC)



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Selecting a Safety Interface

Rockwell Automation

1. How complex is your safety system?
2. What type of input devices?
3. What type of outputs are required?
4. What category stop is required?
5. What is the required Performance Level?
6. Do you require communications?

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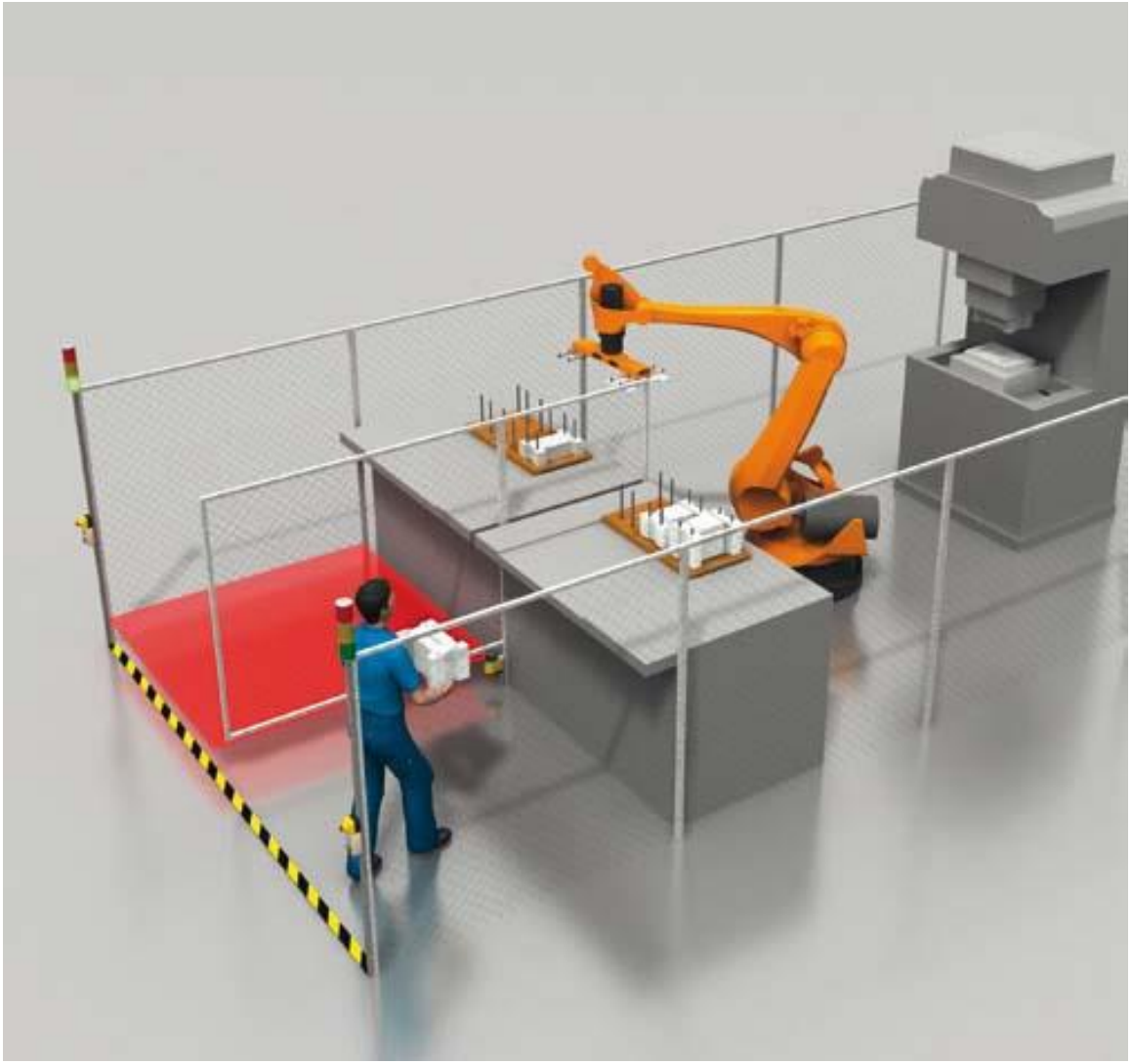
Zoning



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What is the complexity of system?

1 Zone	1-3 Zones	4+ Zones
GSRx	GSRx	GSRx
MSRx	SmartGuard	SmartGuard
	MSR300	GuardLogix

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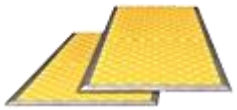
What Type of Inputs do you Require?

Rockwell Automation

2 NO Contacts	1 NO 1 NC Contact	Quadrature
Solid State - OSSD	Mat – Short Circuit 	Induction Motor – Back EMF
2 Hand Control – 500ms C/O	Edge – Circuit Resistance	Inductive Prox. – Hi Freq.

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What types of output devices?

- Contactors
- Motor Drives
- Motion Drives
- Pneumatic Valves
- Hydraulic Valves
- Lasers
- Thermal
- Other

Load Type	Output Type
AC Load DC Load – High Current	Electromechanical Relay
DC Load – Low Current	Solid State

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What category of stop is required?

Rockwell Automation

- Cat 0 – Immediate removal of power (coast to stop)
- Cat 1 – Brake and then removal of power
- Cat 2 – Stop with power left to actuators

Stop Category	Output Timing
0	Immediate
1	Immediate and Off Delay
2	Not used for Safety

Is other delay timing required? Is a jog function required?

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What is the PLr?

Rockwell Automation

PLd / SIL 2

- Input devices can be cascaded
- Two channels in one interlock
- Monitoring, where practicable

PLe / SIL 3

- Electromechanical devices must be connected directly to relay
- Some self-monitoring input devices can still be connected in series, for example SensaGuard
- Redundant outputs must be monitored

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Are Communications Required?

- Most safety systems use an auxiliary status signal (or contact) to communicate ON and OFF status to the machine control system.
- Generally communications are only available with electronic programmable controllers
- GSR Roadmap to include an DLR Ethernet diagnostics module complete with Logix AOP

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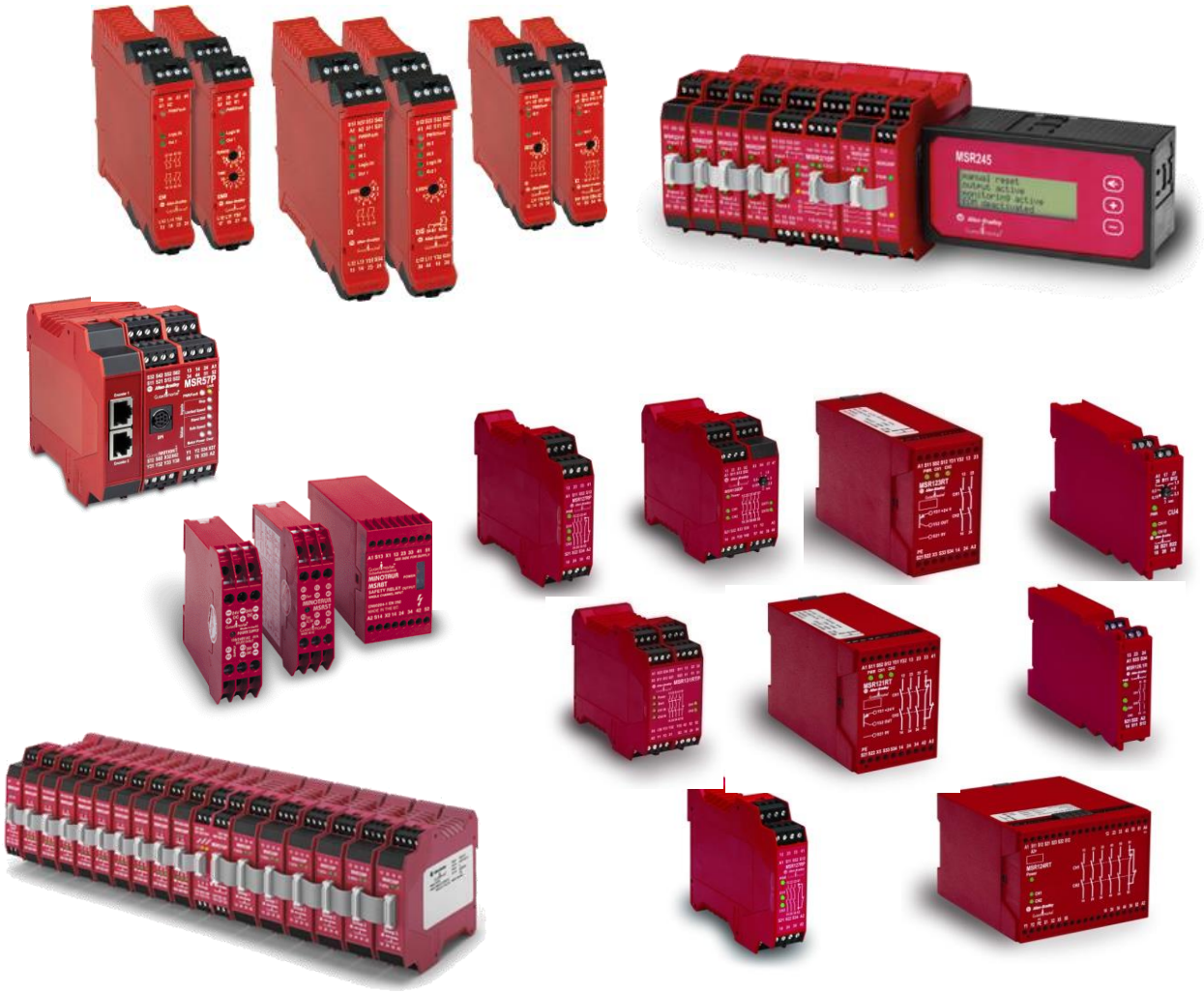
Safety Logic Controllers

- MSR100 - Single Function Relays
- GSR – Modular Relay System
- MSR200 – Modular Safety Relay System
- MSR300 – Configurable Safety Relay System



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Highlight – MSR100 Safety Relay

Rockwell Automation

- Broad range of safety monitoring relays
- Applications up to Cat. 4, PLe EN & SIL 3
- Wide range of input voltages 24AC/DC,110AC, 240AC
- 22.5mm & 45mm housing
- OSSD or dry contact inputs & outputs
- Wide range of contact layouts
- Auto / manual reset & EDM functionality
- Delayed outputs modules - control stop to EN60204-1
- 2 Hand Control, Muting, Stop Motion, Back EMF, Mats, Edges & Expansion Packs

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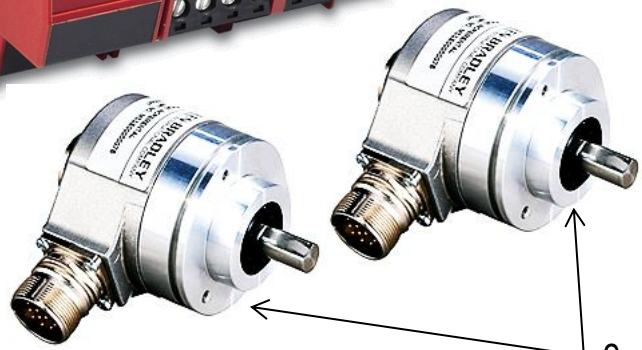
Highlight – MSR57P

- Safe Stop
- Zero Speed Monitoring
- Safe Limited Speed
- Safe Direction
- Safe Acceleration and Deceleration
- Dead man switch control



Programmable with Drive Explorer

Multi-axis applications

8 Diagnostics LED

Stop Category 0,1,2

2 x Encoder Input, TTL or Sin/Cos

6 OSSD Outputs

4 Solid State Auxiliary Outputs

SIL3, PLe, Cat. 4

Non K6K and PF755 customers will require MSR57P to solve their safety applications

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Highlight – GuardMaster Safety Relay

- Platform for future Safety Relay development
- 2012 “Control Engineering” Engineers Choice Award
- 22.5mm housing for 2 x dual channel inputs
- Configuration & zoning via selector switch
- 7 x modules consolidate 85% of MSR applications
  - SI – Single Input
  - DI – Dual Input Relay Out
  - DIS – Dual Input OSSD Out
  - CI – Terminal Layout as MSR
  - EM – Expansion Module
  - EMD – Expansion Module Delayed Outputs
  - GLP – Prox. Monitor for Safe Stop

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Highlight – GuardMaster Safety Relay

Universal Inputs

- Supports numerous sensor types such as E-Stops, interlock switches, light curtains and mats
- Automatic enabling of cross-loop monitoring

Logic

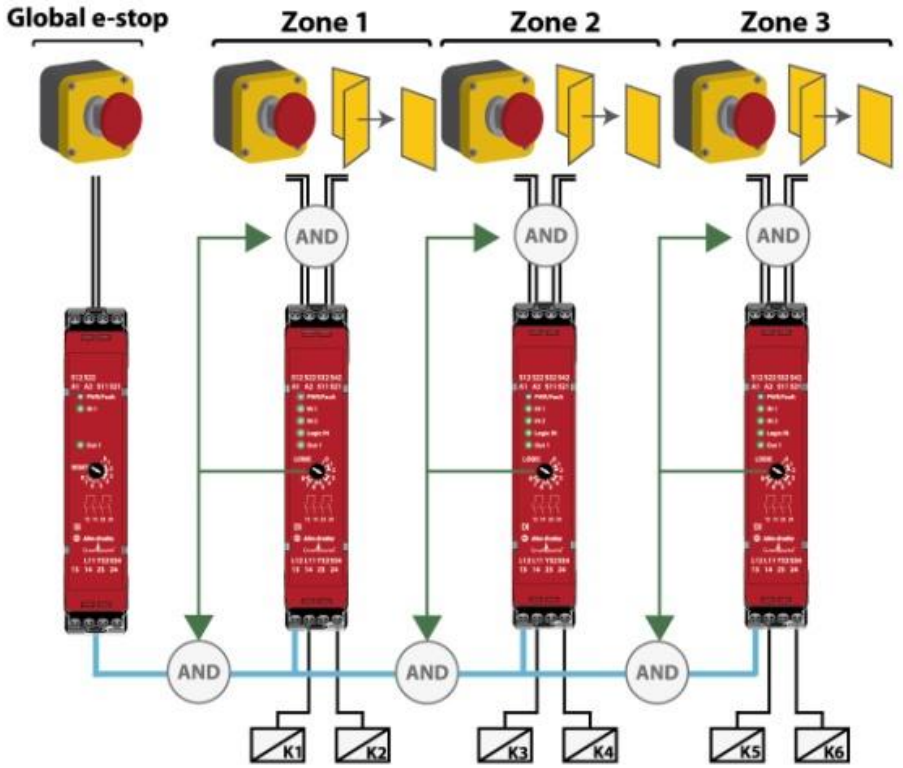
- Simple AND/OR logic between stand-alone units via single wire cascading
- logic combination of input devices on dual input modules

Configuration

- Automatic/manual and manual monitored Reset
- Logic for inputs and SWC
- Timing functions and ranges on Timer modules

Single Wire Cascading (SWC)

- Cascading of safety functions in multi zone applications
- Logic combination of stand alone units



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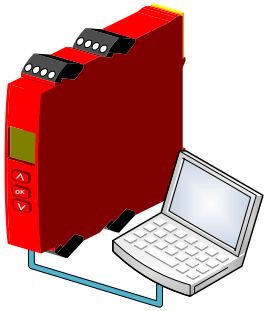
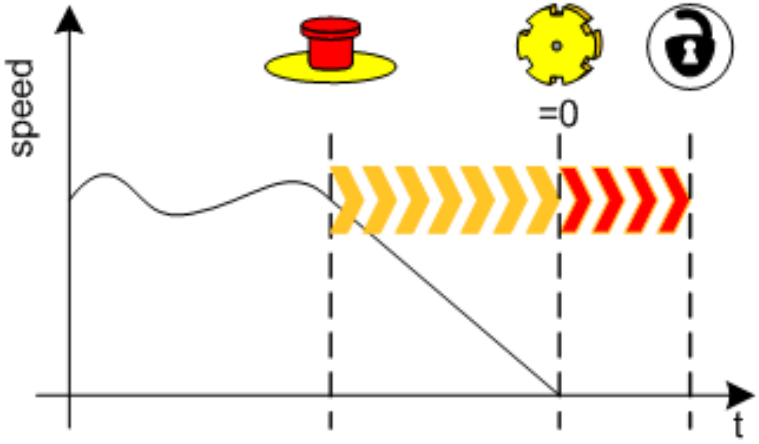
Highlight – GuardMaster Safety Relay

Rockwell Automation

- New addition - GSR GLP
  - Safe Speed and Zero Speed Monitor
  - Uses 2 x Prox (3KHz Frequency)
  - SIL2, PLd
  - Works with SafeSpeed Drives
  - Works with TLSZ-GD2

- Coming Soon – GSR COMMS
  - Remote Diagnostics
  - DeviceNet
  - EthernetIP - DLR





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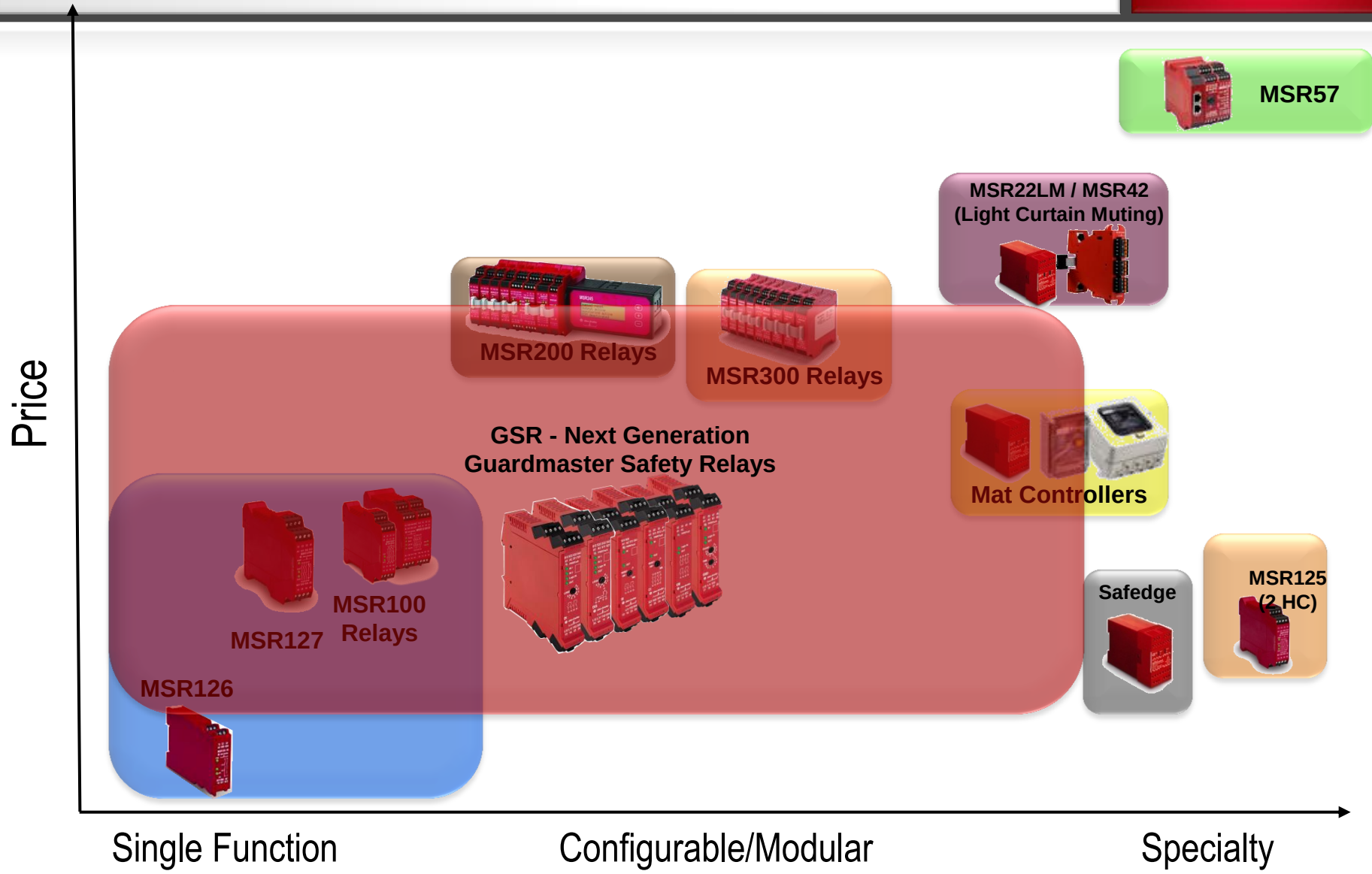
AB Safety Relay Family Positioning Overview

Rockwell Automation



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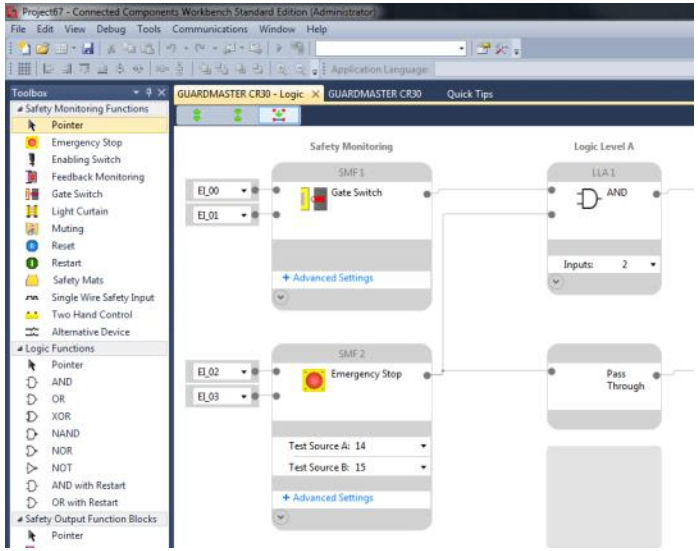
NEW- Guardmaster 440C-CR30 Software Configurable Safety Relay

Rockwell Automation

- CR30 Software Configurable Safety for machine safety applications
- PLe and SIL 3
- 22 Safety I/O
- Supports expanded standard I/O via plug-in
- Configured using free Connected Components Workbench™ software
- Intuitive software simplifies configuration



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Guardmaster 440C-CR30 Safety Relay

2080 Plug in Support

Rockwell Automation

2080-IQ4OB4 plug-in for expansion I/O:

Standard Input Expansion:

- Use standard inputs for standard signals such as circuit resets, feedback monitoring or muting sensors

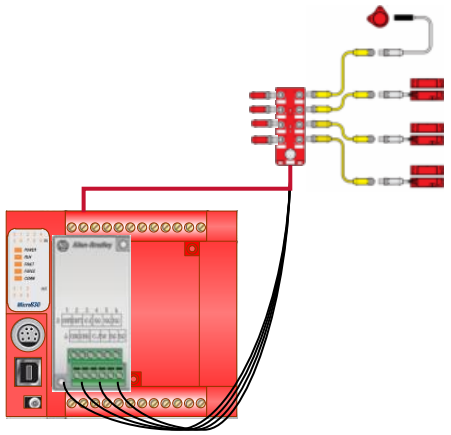
Reset

Feedback Monitoring

Muting Sensors

Standard Diagnostics:

- Land auxiliary contacts of series wired safety devices and share with PanelView Component terminals
- Use standard outputs to drive indicator LEDs or send gate unlock commands



Expansion I/O with no impact to panel footprint

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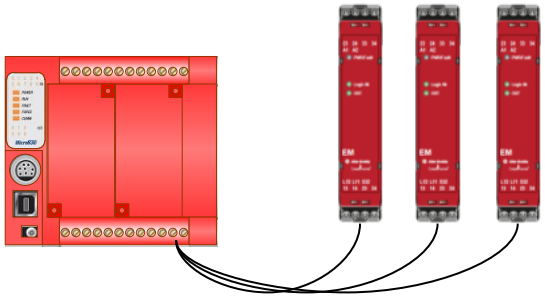
Guardmaster 440C-CR30 Safety Relay

Single Wire Safety Support

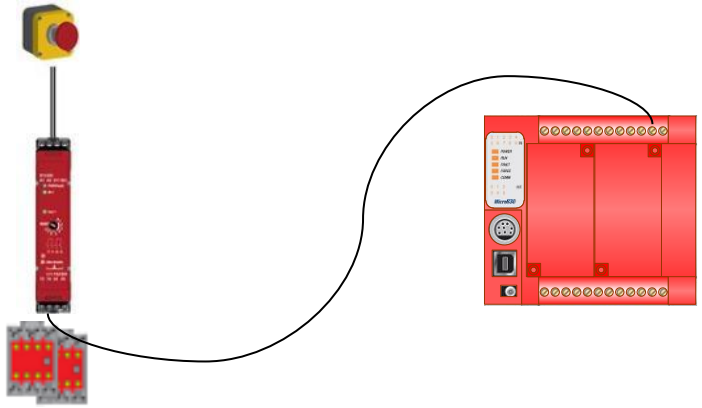
Rockwell Automation

Supports Single Wire Safety for easy integration of GSR relays:

- Add Safety Relay Outputs
  - Add multiple dry contact outputs by utilizing GSR EM (Expansion module) while only consuming a single safety output configured for Single Wire Safety



- Connect Upstream GSR Relays
  - Expand inputs and functionality using GSR relays by connection through Single Wire Safety



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NEW-Guardmaster 440G-LZ

- Safety certified to PLe and Cat. 4
  - EN/ISO 13849-1
  - EN/ISO 14119:2013
- Solid state design and monitored outputs
- Scalable protection with Unique or Standard coded RFID actuators
- High holding force of 1300N (Fzh)
- Energy Efficient "**Green**" Device: only uses 2.5W
- IP69K and hygienic design
- Power-to-Release and Power-to-Lock versions
- Compact design optimized for ease of mounting
- Diagnostic info provided with 2 bright 270° LEDs

Actuator
Metal holding bolt (inserts into the metal bracket and sensor assembly)
440G-LZ
Bar code with URL link to user manual
LEDs (both sides)
Global approvals
Slim, clean design, sealed body (IP69k)

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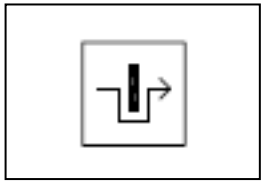
Standards compliance

- The 440G-LZ provides the highest safety rating with PLe and Category 4
  - EN/ISO 13849-1
  - EN/ISO 14119:2013
- A required symbol from the EN/ISO 14119:2013 standard is marked on the device to show that the switch has this safety-rated lock monitoring function



- The safety function and safety outputs include **both** the monitoring of the guard position and lock status
  - **Only product on the market that is TÜV certified for PLe for BOTH the door position and lock monitoring**

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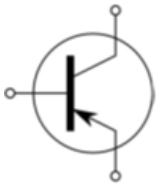
Solid-state safety outputs and design

Rockwell Automation

- With the 440G-LZ solid state design it can be connected in series with other devices such as Light Curtains and SensaGuard™ switches while maintaining a PLe rating
  - Exceeds requirements of ISO TR 24119 referenced in the new EN/ISO 14119:2013 standard
- Short circuit protection
- Overload protection
- Cross fault (channel to channel) detection
- Designed to switch DC powered devices
  - Supports switching of up to 200 mA



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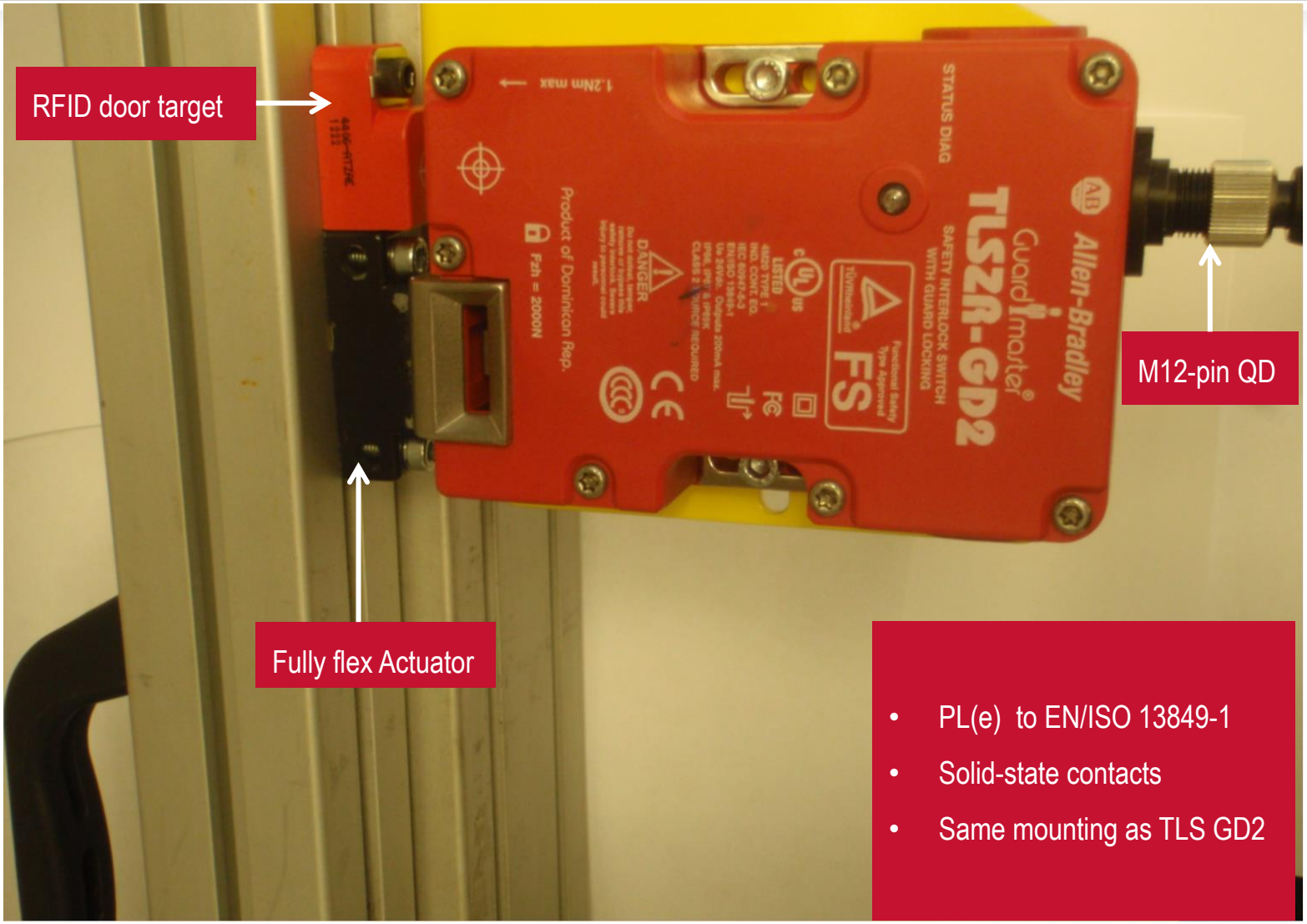
NEW- TLS-Z GD2 Overview



- PL(e) to EN/ISO 13849-1
- Solid-state contacts
- Same mounting as TLS GD2

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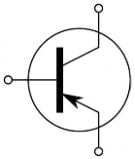
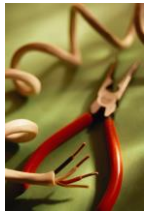
Key Features

- RFID door target……..
- Solid-state contacts…… 
- Identical profile to standard TLS GD2……
- TÜV certified to Performance Level “e” to EN ISO 13849-1……
- Available in power-to-release or power-to-lock format…
- Easy wiring with M12 8-pin quick disconnect……
- Easy-to-connect 
- Visual diagnostic……..

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RFID Door target

- Uniquely coded RFID door target and a built-in inductive sensor inside the switch signals the door position to the internal microprocessor
- Mounts close coupled to the fully flexible actuator
- Based on proven SensaGuard™ technology
- Automatic learn process at startup, can choose either “one-time” or “multi-time” learn (8x)
- Available as a spare part

Will detect if the key breaks or if the actuator separates from its door mounted position

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inaco
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VALUED | Products | Services | Solutions

Rockwell Automation
A-B QUALITY
Authorised Distributor
Allen-Bradley · Rockwell Software

Integrated Safety Solutions-
Voltage Indicators Communication Portals and IR Windows

Definition – PESDs(Permanent Electrical Safety Devices):

...are permanently mounted to electrical systems and reduce arc flash and shock hazard risks.

…provide voltage verification without exposure to voltage.

…are directly connected to voltage(s) source(s) within an electrical enclosure.

…provide multiple voltage state determinations; audible, visual indications, and/or a physical action by the worker.

…label all voltage sources wired to PESDs (NFPA 70E 120.1(1))

GRACE ENGINEERED PRODUCTS,INC

Voltage Indicator:

A ‘Voltage Only’ device that illuminates when voltage is present between any 2 phases.

Hardwired

Checks L1-L2-L3-GRD Simultaneously 24/7/365

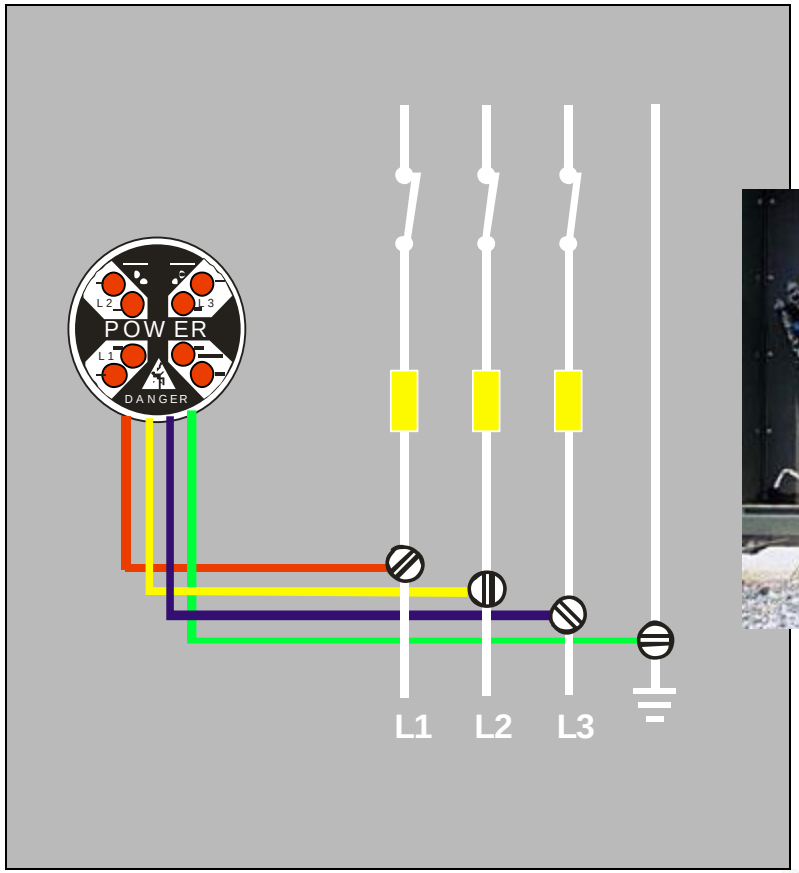
AC/DC Operation
(40-750VAC/30-1000VDC)

Class 1 Division 2 Rated

Powered by Line Voltage - No Batteries

Cat III & IV Rated

Long Life LED’s



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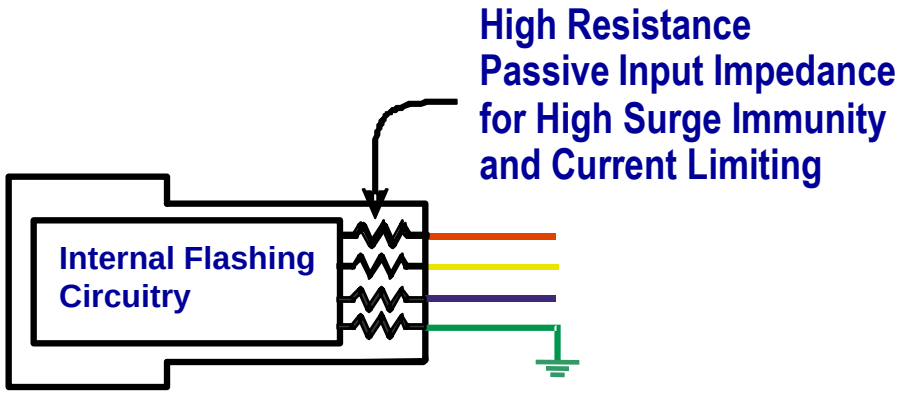
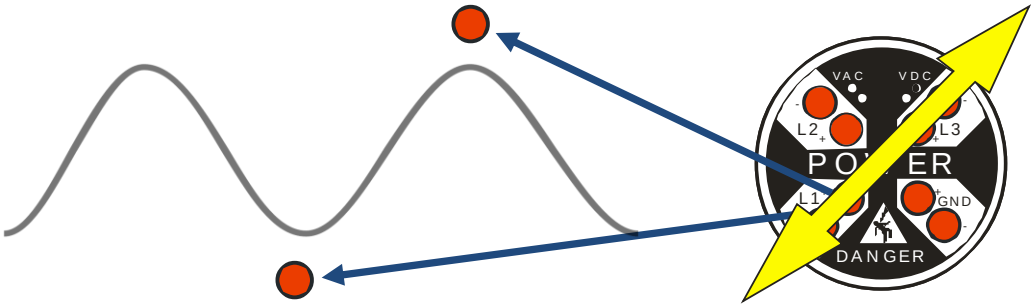
Voltage Indicator:

Reliability



Voltage if Illuminated



Dual (+/-) LED's per Phase

Complete circuit needs two phases

Written procedure must validate device

GRACE ENGINEERED PRODUCTS, INC

Advantages over a Voltmeter

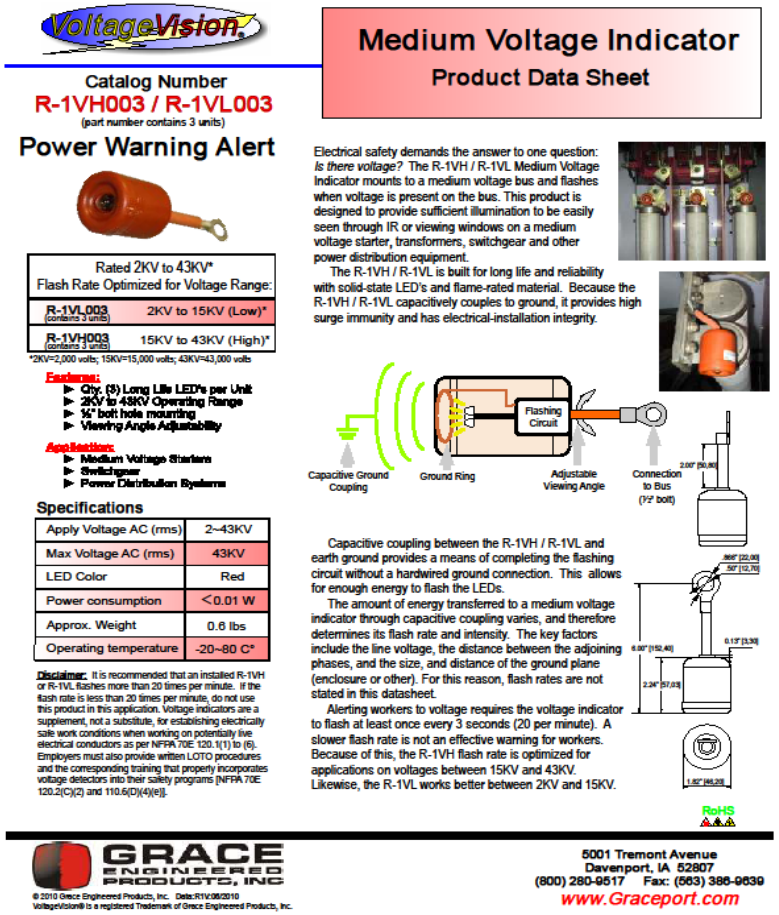
- 'Voltage only' device.
- Hardwired to the voltage source.
- Permanent-less opportunity for damage.
- Checks L1-L2-L3-GRD 24/7/365.
- Detects both AC & DC (Stored energy).
- Self-powered (no batteries).
- 'Visual blade' indication.

NEW Medium Voltage Indicator

Bolts to each LOAD SIDE phase.
Red flashing LED's can be viewed through enclosure window.

Point towards window.

In Stock



VoltageVision

Catalog Number
R-1VH003 / R-1VL003
(part number contains 3 units)

Power Warning Alert

Medium Voltage Indicator
Product Data Sheet

Rated 2KV to 43KV* Flash Rate Optimized for Voltage Range:	
R-1VL003 (contains 3 units)	2KV to 15KV (Low)*
R-1VH003 (contains 3 units)	15KV to 43KV (High)*

*2KV=2,000 volts; 15KV=15,000 volts; 43KV=43,000 volts

Features:
- Qty. (3) Long Life LED's per Unit
- 2KV to 43KV Operating Range
- ½" bolt hole mounting
- Viewing Angle Adjustability

Applications:
- Medium Voltage Starters
- Switchgear
- Power Distribution Systems

Specifications

Apply Voltage AC (rms)	2~43KV
Max Voltage AC (rms)	43KV
LED Color	Red
Power consumption	<0.01 W
Approx. Weight	0.6 lbs
Operating temperature	-20~80 C°

Disclaimer: It is recommended that an installed R-1VH or R-1VL flashes more than 20 times per minute. If the flash rate is less than 20 times per minute, do not use this product in this application. Voltage indicators are a supplement, not a substitute, for establishing electrically safe work conditions when working on potentially live electrical conductors as per NFPA 70E 120.1(1) to (6). Employers must also provide written LOTO procedures and the corresponding training that properly incorporates voltage detectors into their safety programs [NFPA 70E 120.2(C)(2) and 110.6(D)(4)(e)].

Electrical safety demands the answer to one question: *Is there voltage?* The R-1VH / R-1VL Medium Voltage Indicator mounts to a medium voltage bus and flashes when voltage is present on the bus. This product is designed to provide sufficient illumination to be easily seen through IR or viewing windows on a medium voltage starter, transformers, switchgear and other power distribution equipment.

The R-1VH / R-1VL is built for long life and reliability with solid-state LED's and flame-rated material. Because the R-1VH / R-1VL capacitively couples to ground, it provides high surge immunity and has electrical-installation integrity.

Capacitive coupling between the R-1VH / R-1VL and earth ground provides a means of completing the flashing circuit without a hardwired ground connection. This allows for enough energy to flash the LEDs.

The amount of energy transferred to a medium voltage indicator through capacitive coupling varies, and therefore determines its flash rate and intensity. The key factors include the line voltage, the distance between the adjoining phases, and the size, and distance of the ground plane (enclosure or other). For this reason, flash rates are not stated in this datasheet.

Alerting workers to voltage requires the voltage indicator to flash at least once every 3 seconds (20 per minute). A slower flash rate is not an effective warning for workers. Because of this, the R-1VH flash rate is optimized for applications on voltages between 15KV and 43KV. Likewise, the R-1VL works better between 2KV and 15KV.

RoHS

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5001 Tremont Avenue
Davenport, IA 52807
(800) 280-9517 Fax: (563) 386-9639
www.Graceport.com

GRACE ENGINEERED PRODUCTS,INC

Example Graceports(R)

- No need to open panel doors for programming - increases safety and productivity
- Can be configured with your choice of connector.
- Port can be powered with Australian 240v outlet.
- Just let us know what configuration you require!

GRACE ENGINEERED PRODUCTS,INC

Example Graceports(R)

GRACE ENGINEERED PRODUCTS, INC

IR Windows: Save Time and Stay Safe

SAFESIDE™
IR Viewing Windows

Before

After

Note: the reduced levels of PPE due to the equipment being in a closed and guarded condition.

SAFESIDE™ IR Viewing Windows

Getting The Right Lens Material

- **Application Consideration**
  - **Is the window for indoor or outdoor use?**
- **Subjected to severe environmental conditions such as:**
  - **UV Exposure**
  - **Humidity**
  - **Rain**
  - **Snow**
  - **Sea water**
  - **Acids or alkalis**
  - **Extreme temperatures**
  - **Vibration**

Find Voltage Before it Finds You!

GRACE ENGINEERED PRODUCTS, INC

inaco automationcontrols

Rockwell Automation
A-B QUALITY
Authorised Distributor
Allen-Bradley · Rockwell Software

Your Questions

Committed to
exceeding our customer's expectations

VALUED | Products | Services | Solutions

inaco automationcontrols

VALUED | Products | Services | Solutions

Rockwell Automation Safety Automation Builder

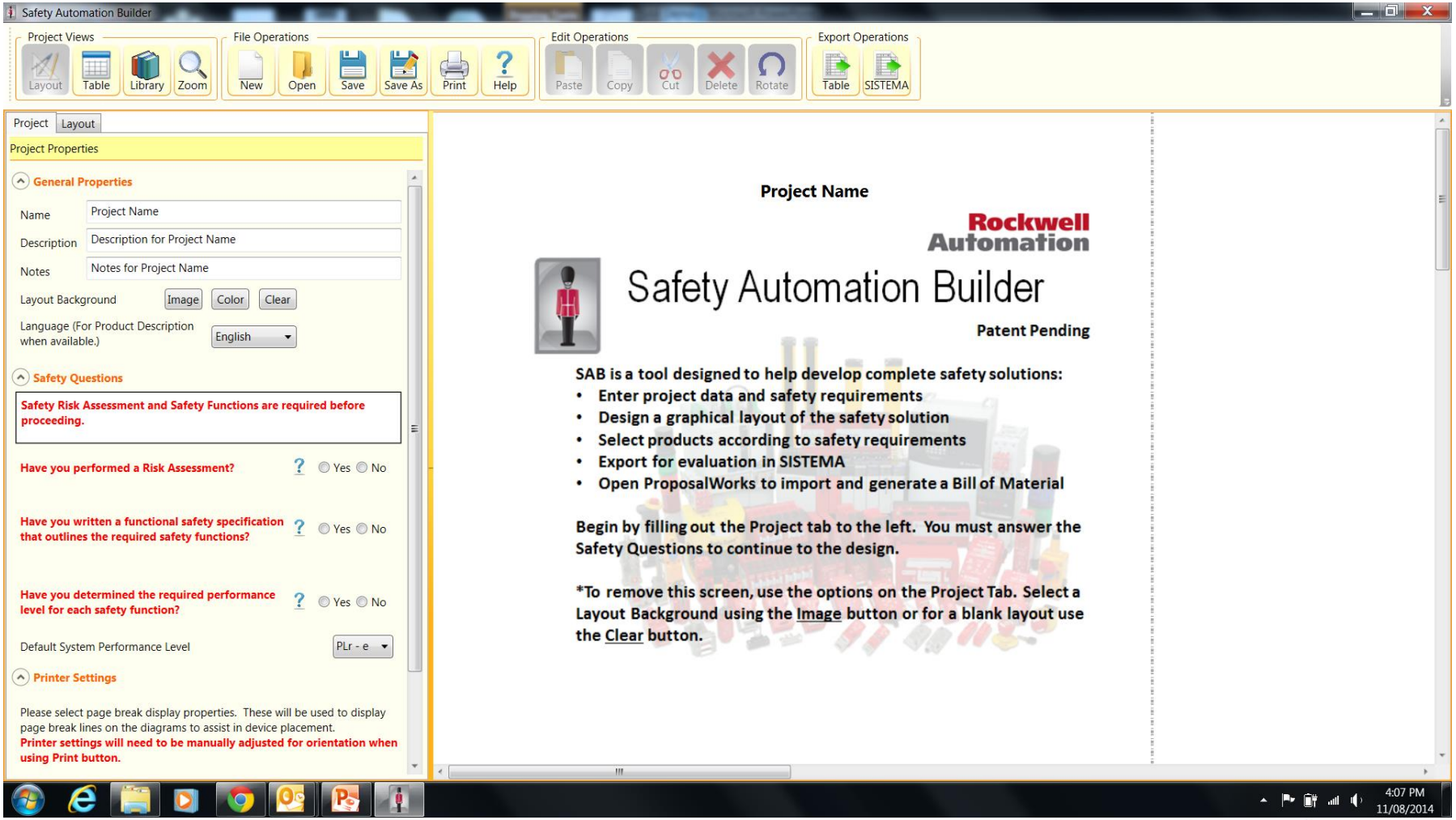
David Cassidy

Safety Automation Builder

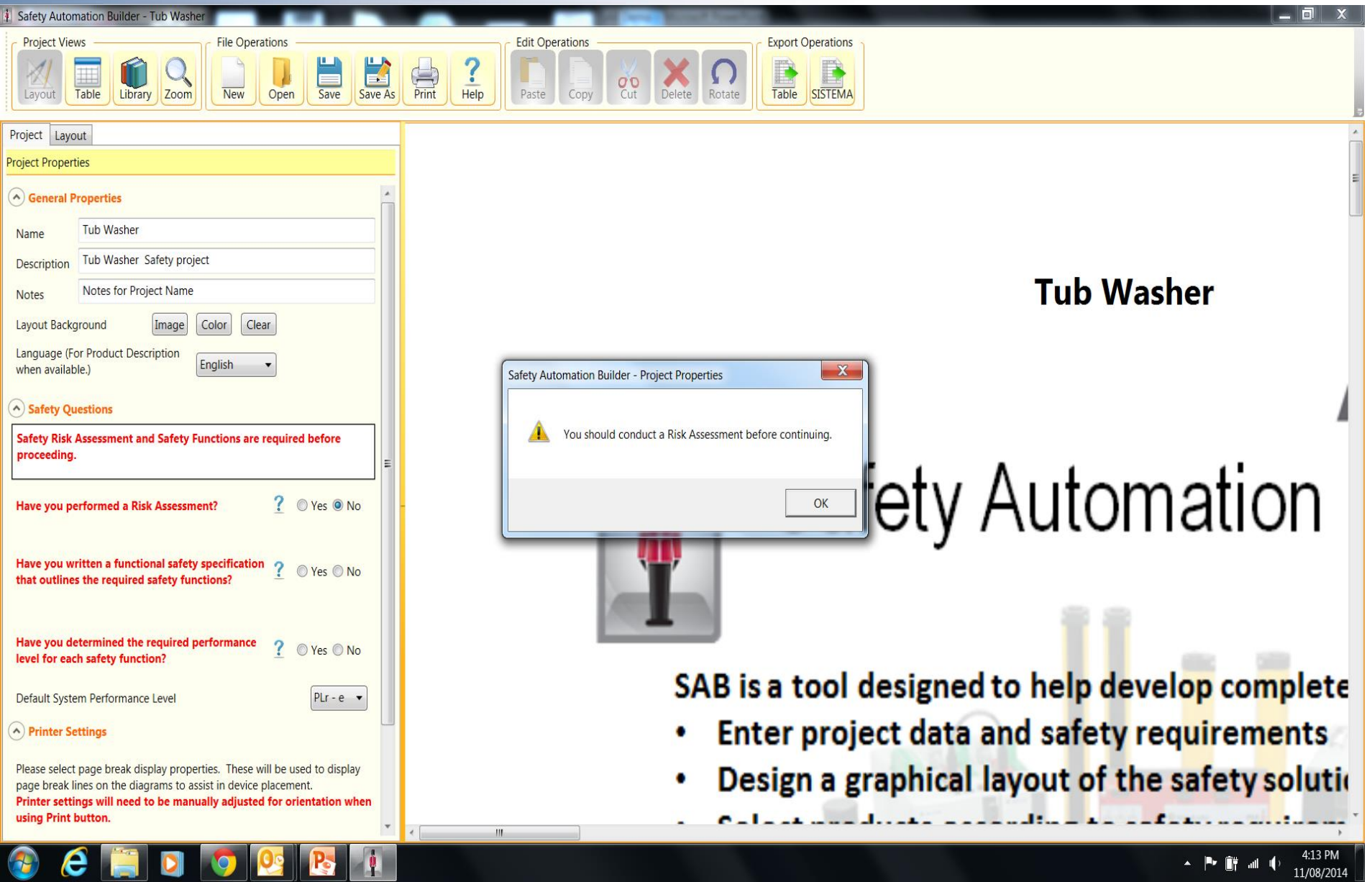
- Rockwell Automation Safety Automation Builder is a free tool that will allow you to-
  - Enter a project and safety requirements
  - Design a layout for the solution
  - Select Products according to safety requirements
  - Export the document to Sistema
  - Open Proposal Works and generate a BOM

Safety Automation Builder

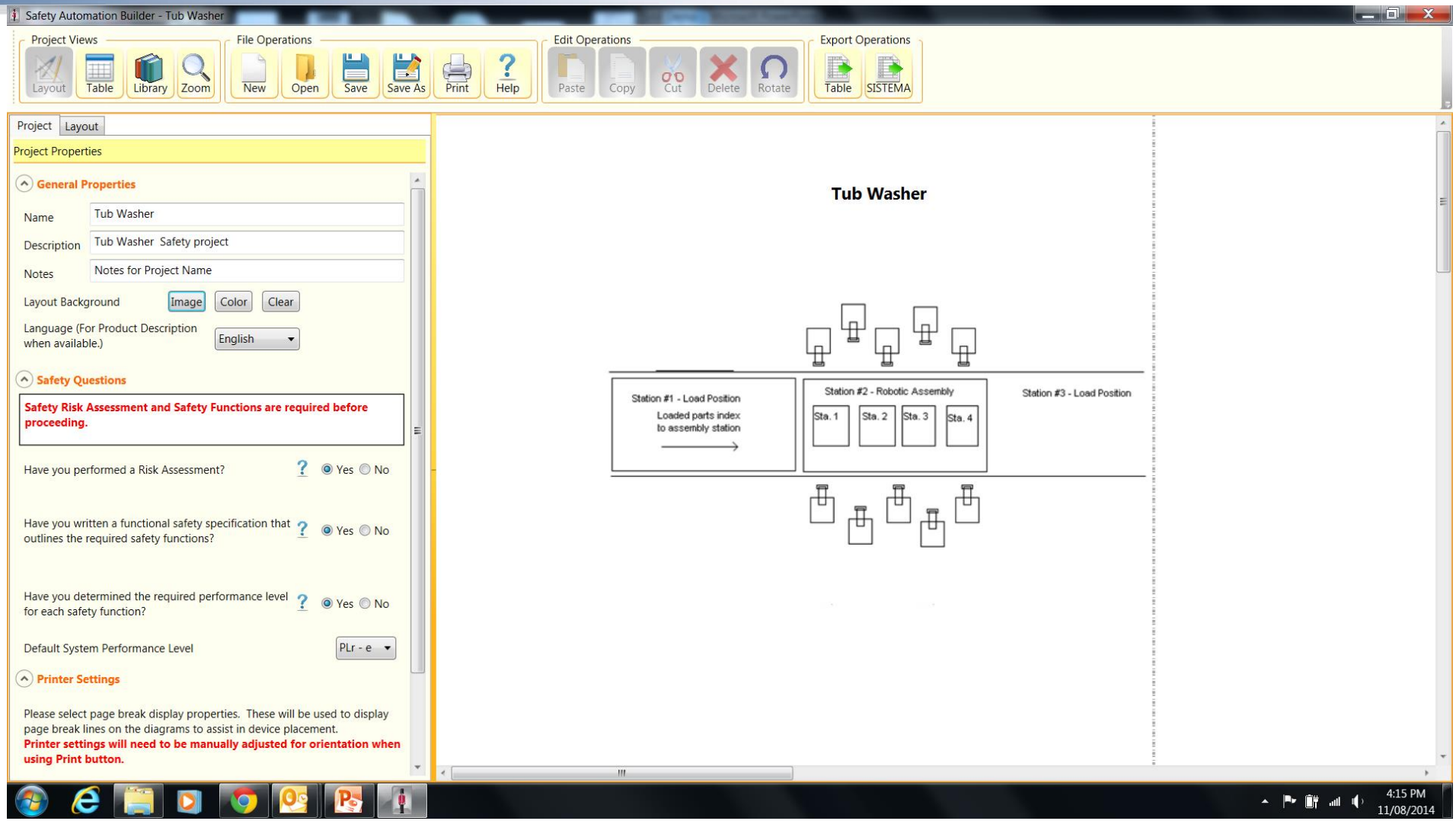
- Lets get started!



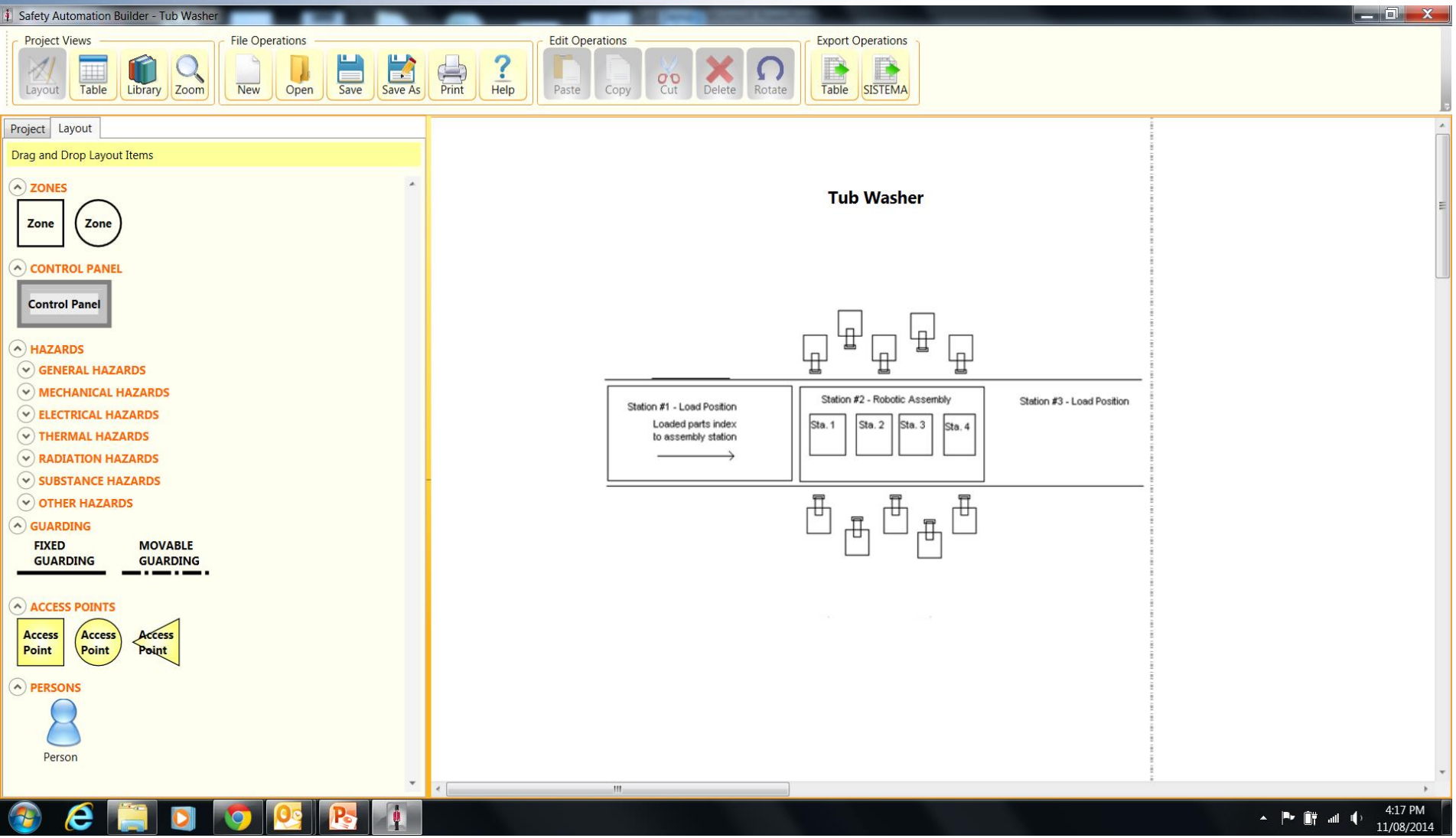
Safety Automation Builder



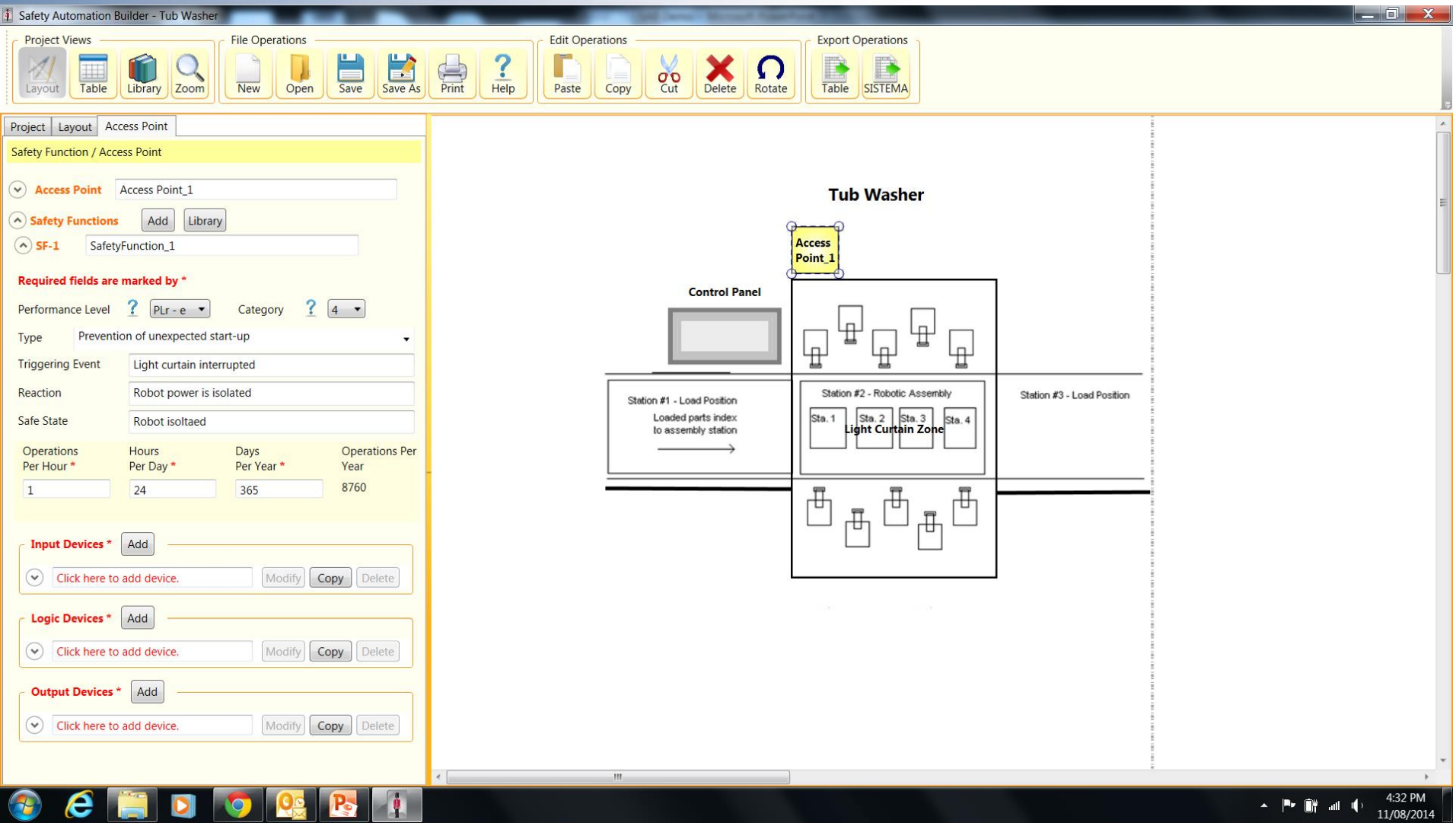
Safety Automation Builder



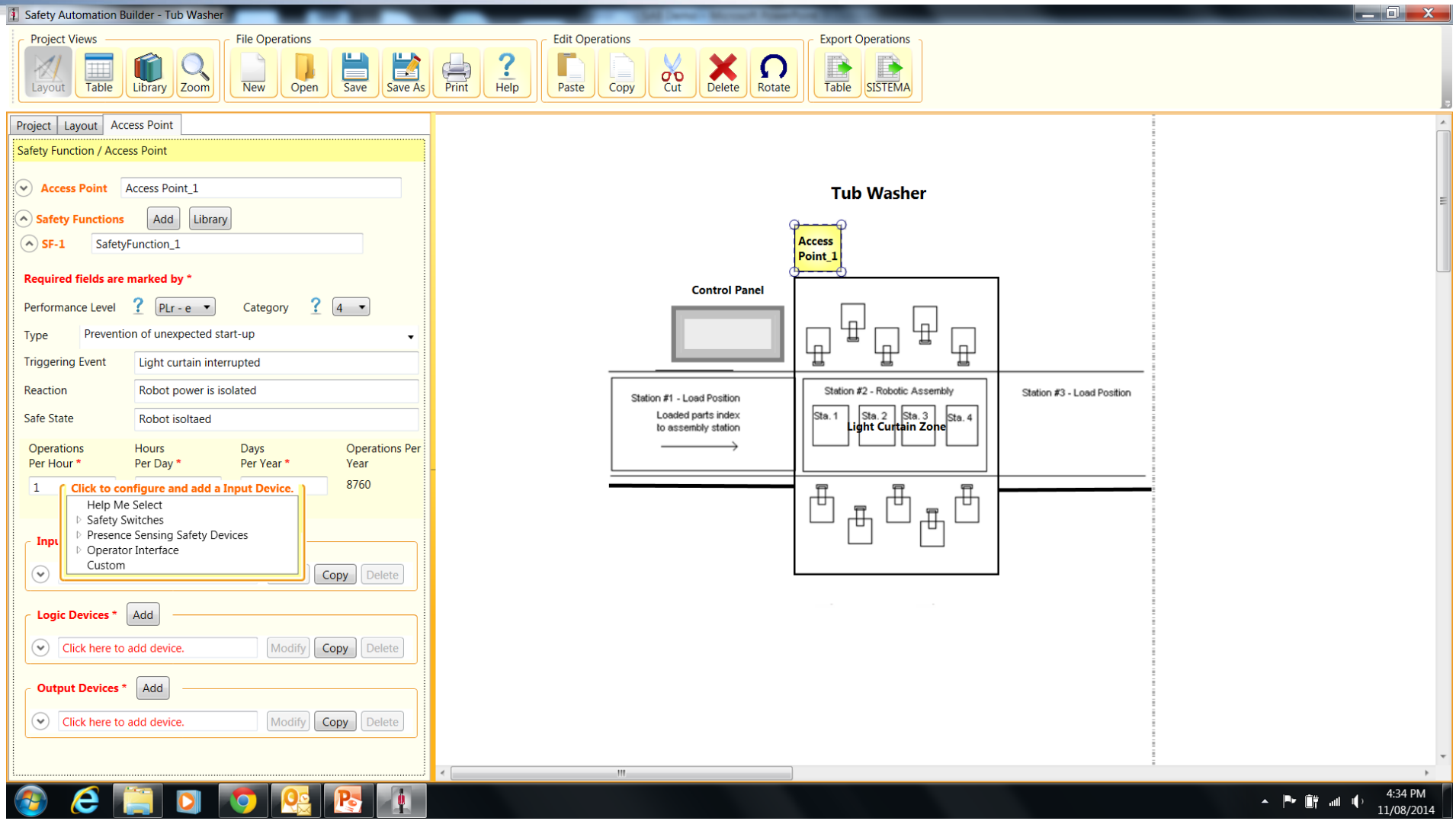
Safety Automation Builder



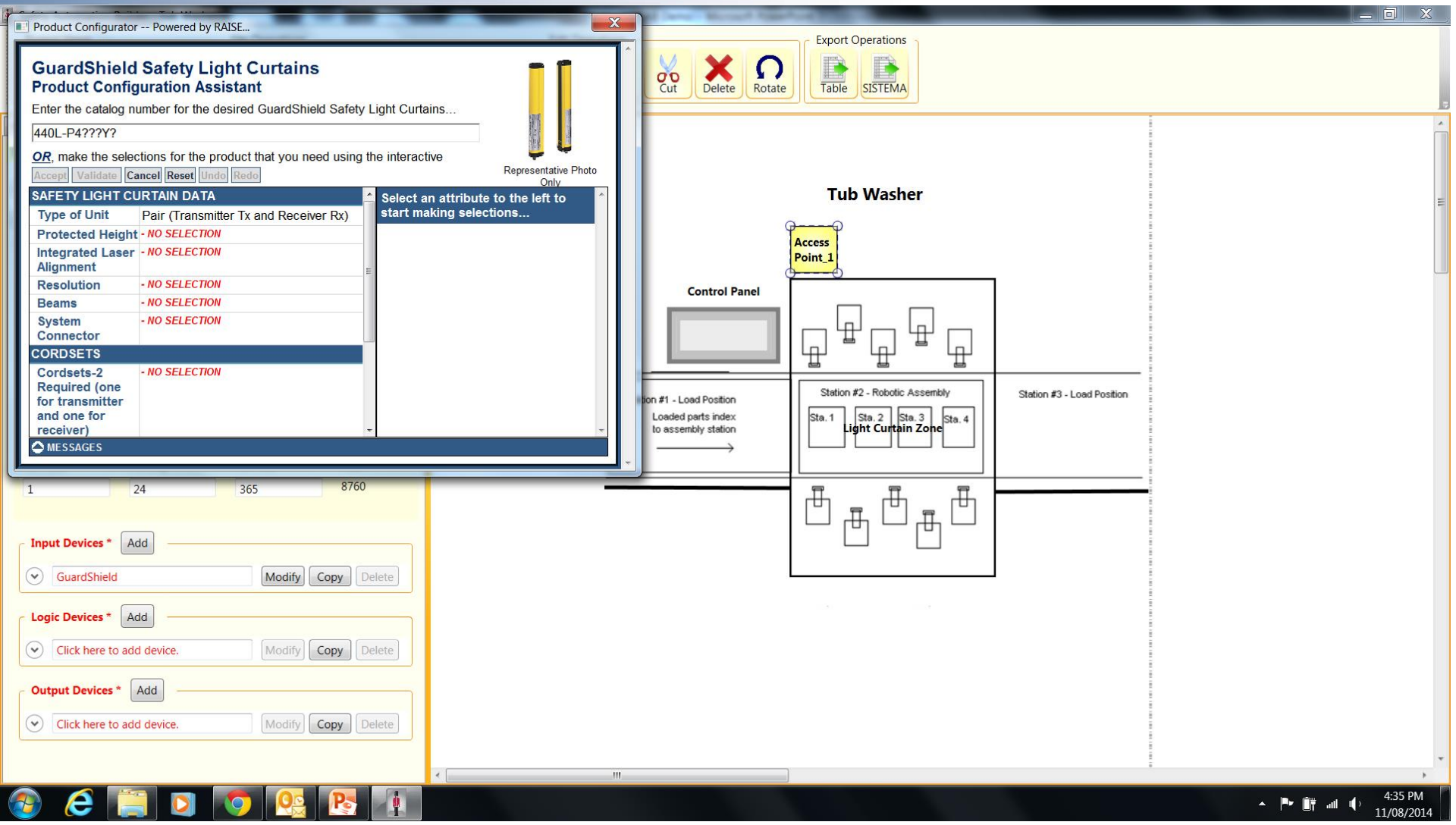
Safety Automation Builder



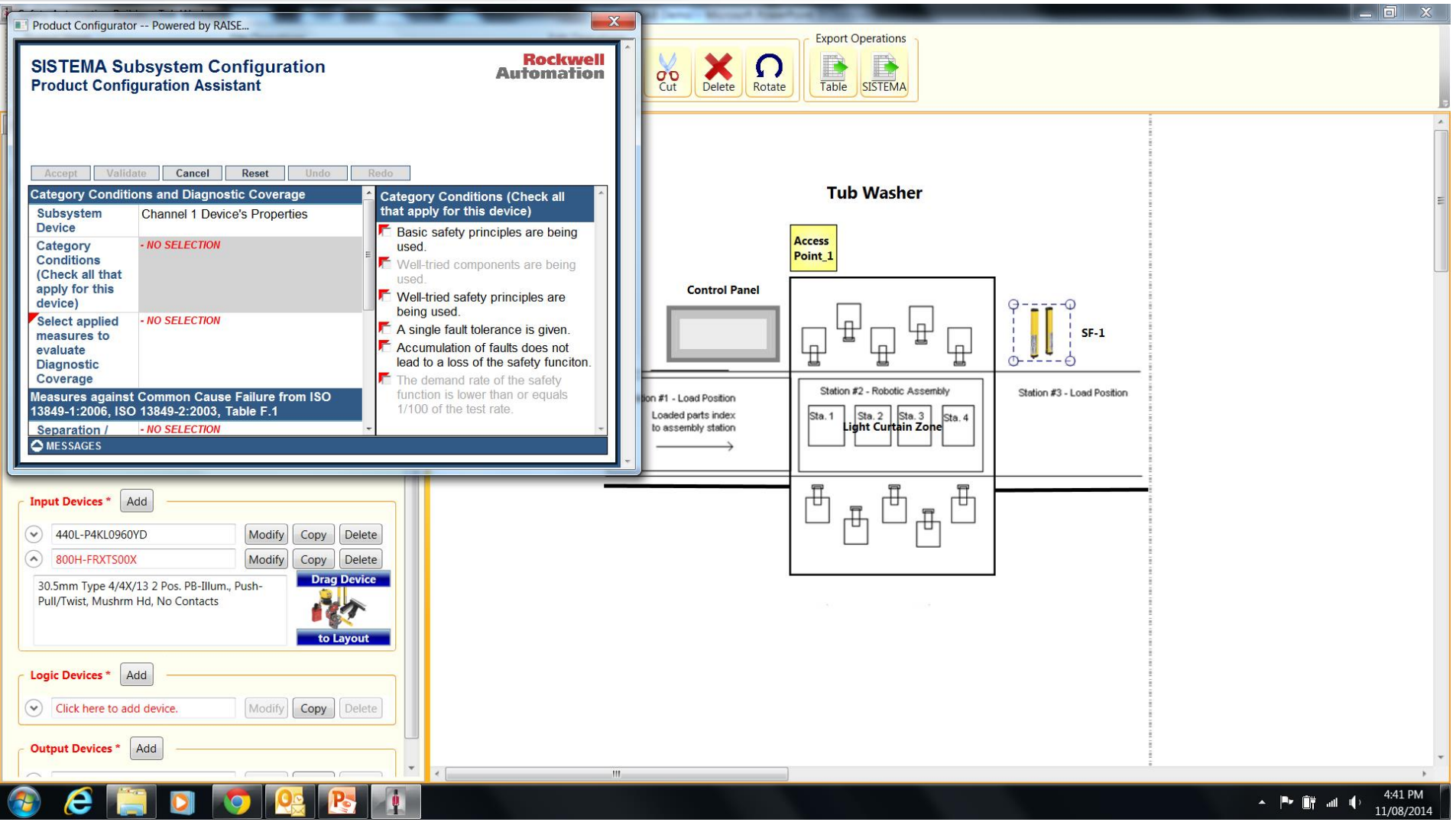
Safety Automation Builder



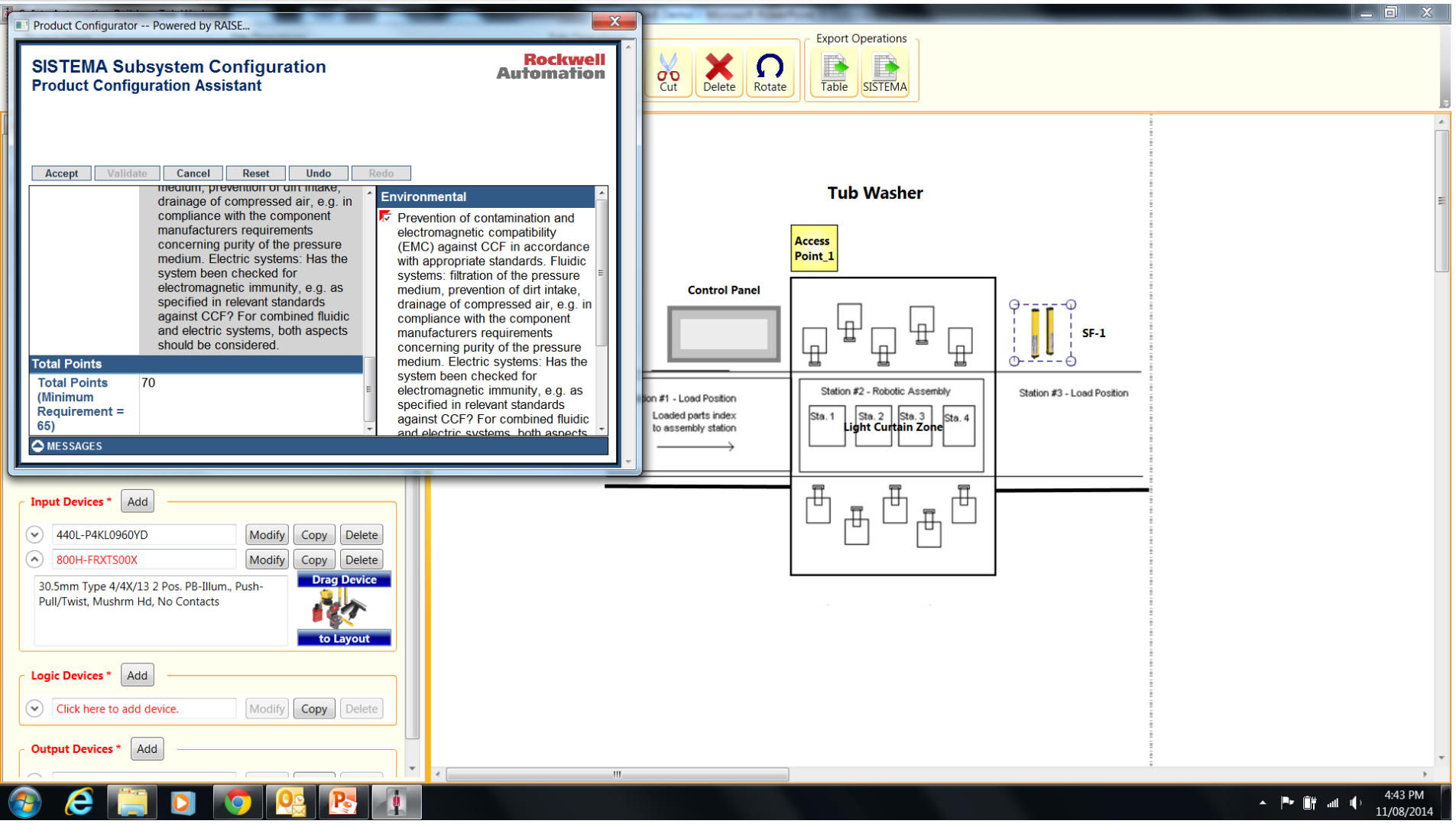
Safety Automation Builder



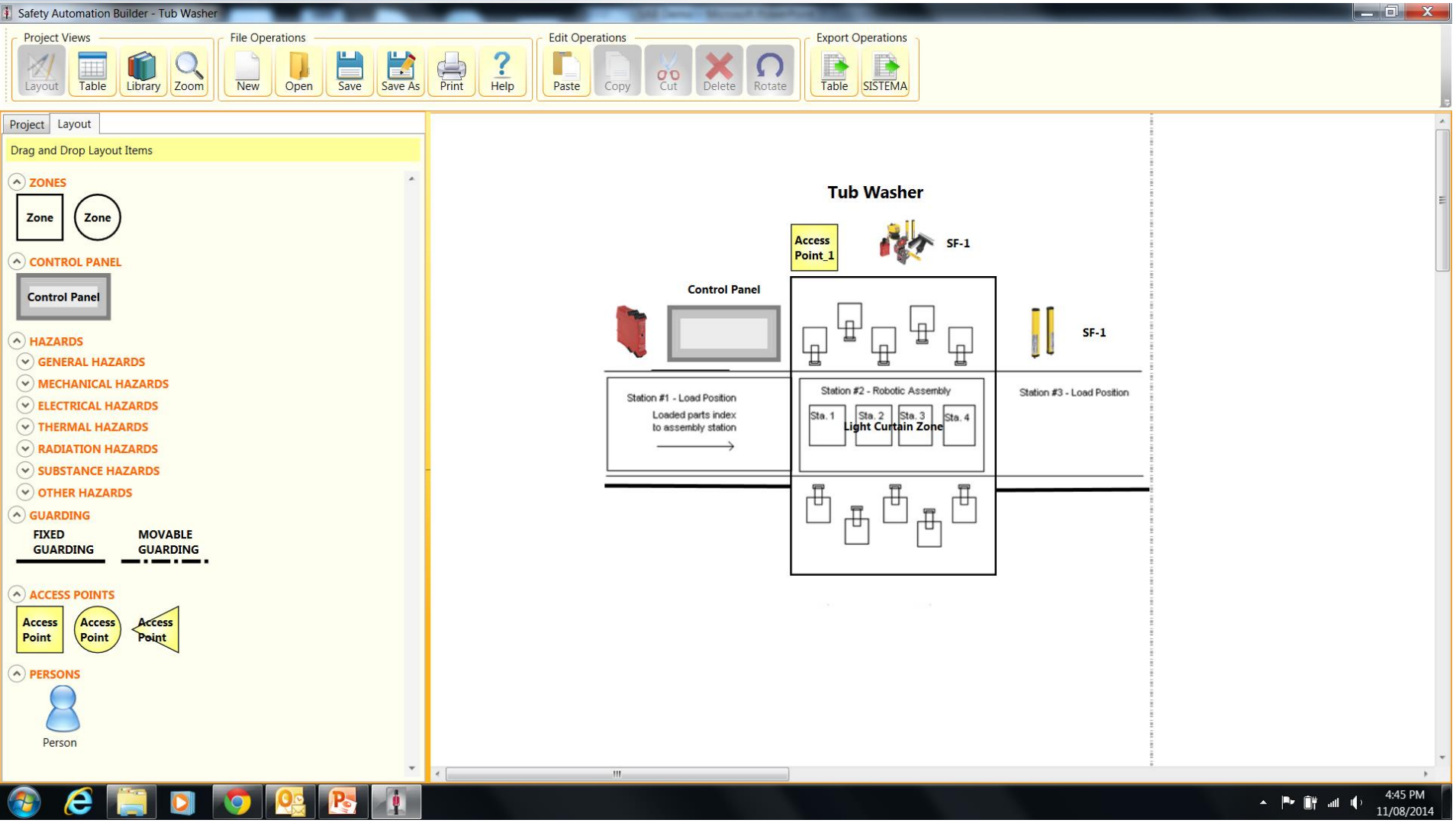
Safety Automation Builder



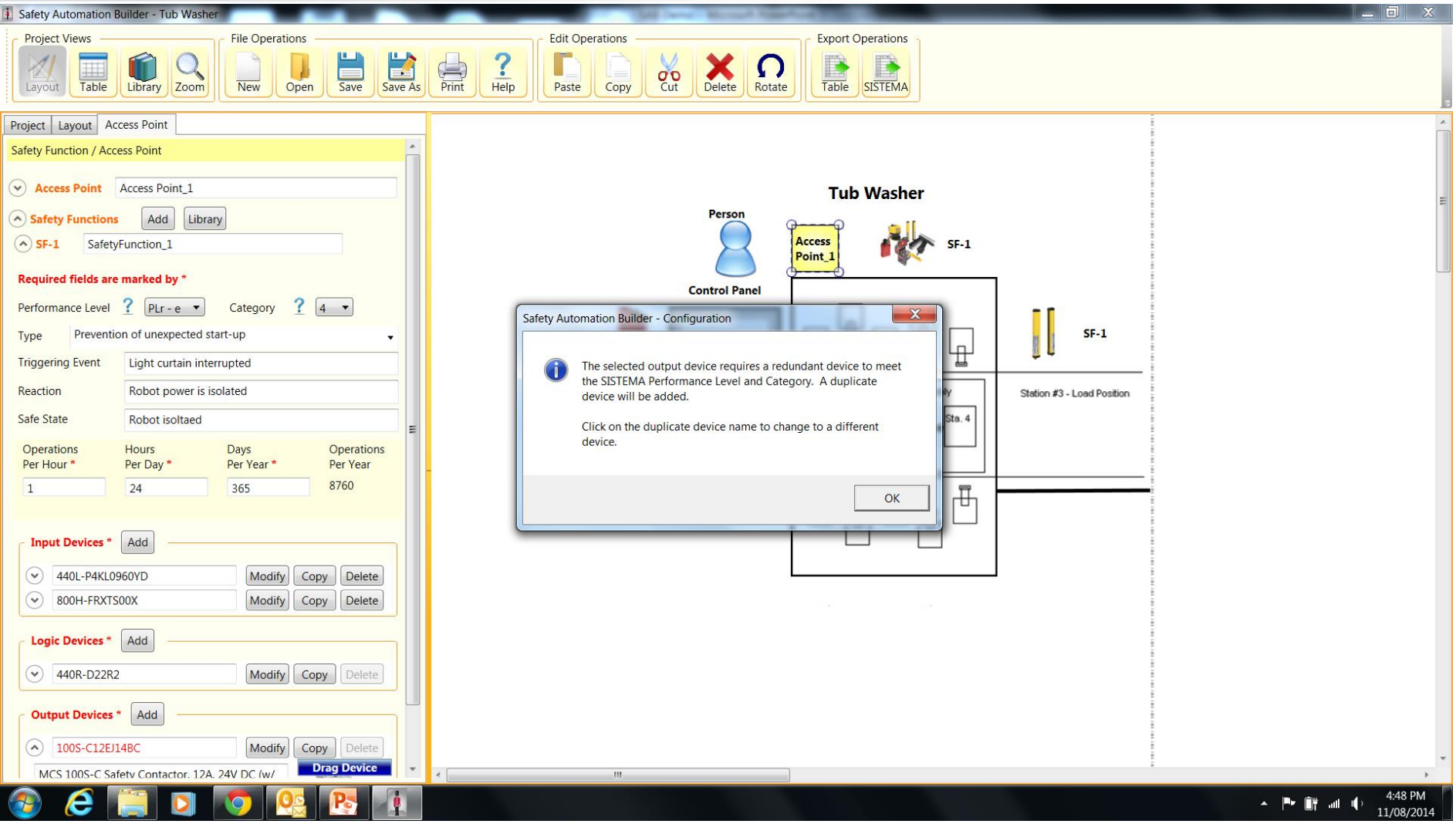
Safety Automation Builder


Product Configurator -- Powered by RAISE...
SISTEMA Subsystem Configuration
Product Configuration Assistant
Rockwell Automation
Accept
Validate
Cancel
Reset
Undo
Redo
drainage of compressed air, e.g. in compliance with the component manufacturers requirements concerning purity of the pressure medium. Electric systems: Has the system been checked for electromagnetic immunity, e.g. as specified in relevant standards against CCF? For combined fluidic and electric systems, both aspects should be considered.
Total Points
Total Points (Minimum Requirement = 65)
70
Environmental
Prevention of contamination and electromagnetic compatibility (EMC) against CCF in accordance with appropriate standards. Fluidic systems: filtration of the pressure medium, prevention of dirt intake, drainage of compressed air, e.g. in compliance with the component manufacturers requirements concerning purity of the pressure medium. Electric systems: Has the system been checked for electromagnetic immunity, e.g. as specified in relevant standards against CCF? For combined fluidic and electric systems, both aspects
MESSAGES
Export Operations
Cut
Delete
Rotate
Table
SISTEMA
Tub Washer
Access Point_1
Control Panel
SF-1
Station #2 - Robotic Assembly
Sta. 1
Sta. 2
Sta. 3
Sta. 4
Light Curtain Zone
Station #3 - Load Position
Loaded parts index to assembly station
Input Devices *
Add
440L-P4KL0960YD
800H-FRXTS00X
Modify
Copy
Delete
30.5mm Type 4/4X/13 2 Pos. PB-Illum., Push-Pull/Twist, Mushrm Hd, No Contacts
Drag Device
to Layout
Logic Devices *
Click here to add device.
Output Devices *
4:43 PM
11/08/2014

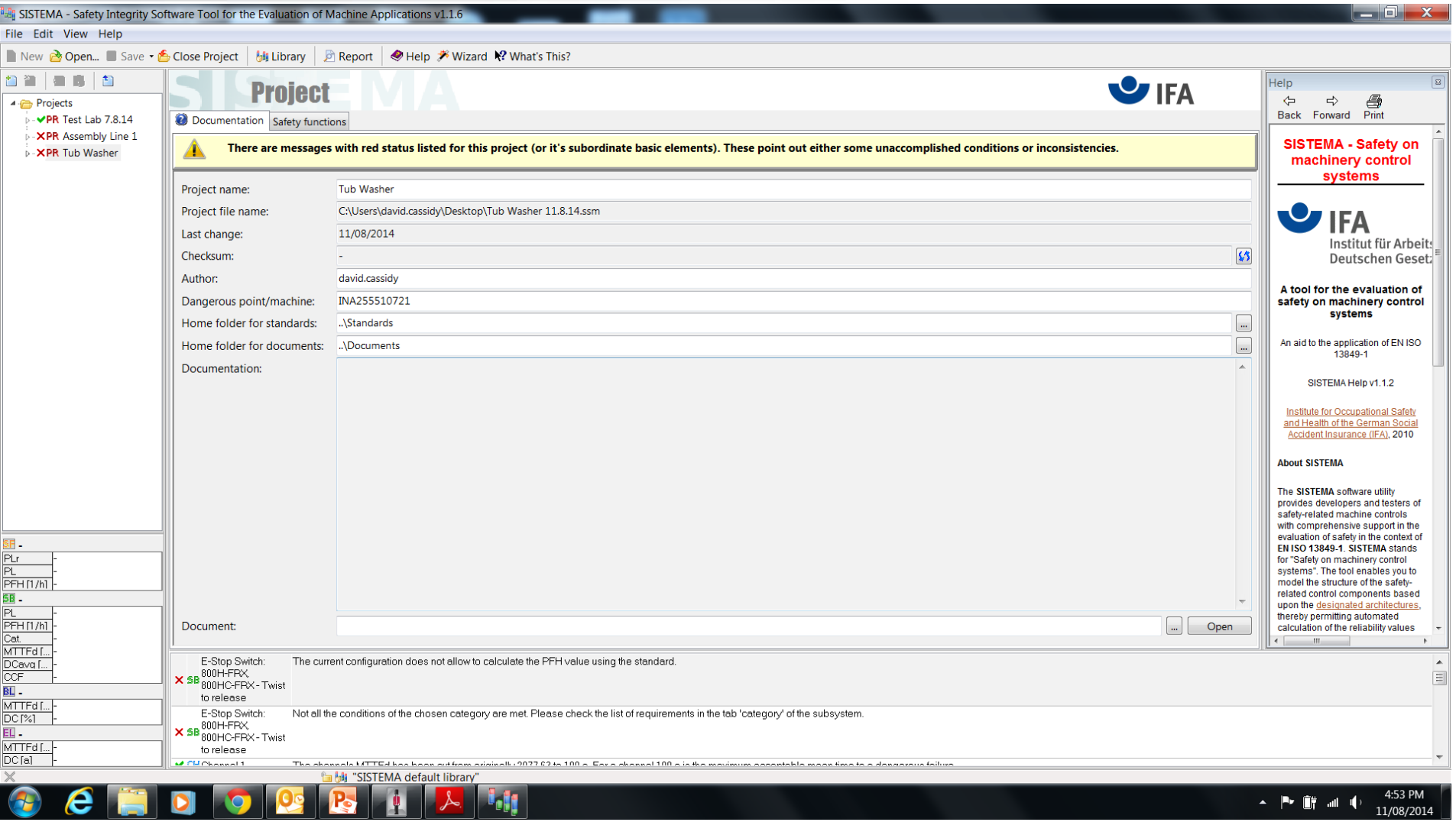
Safety Automation Builder



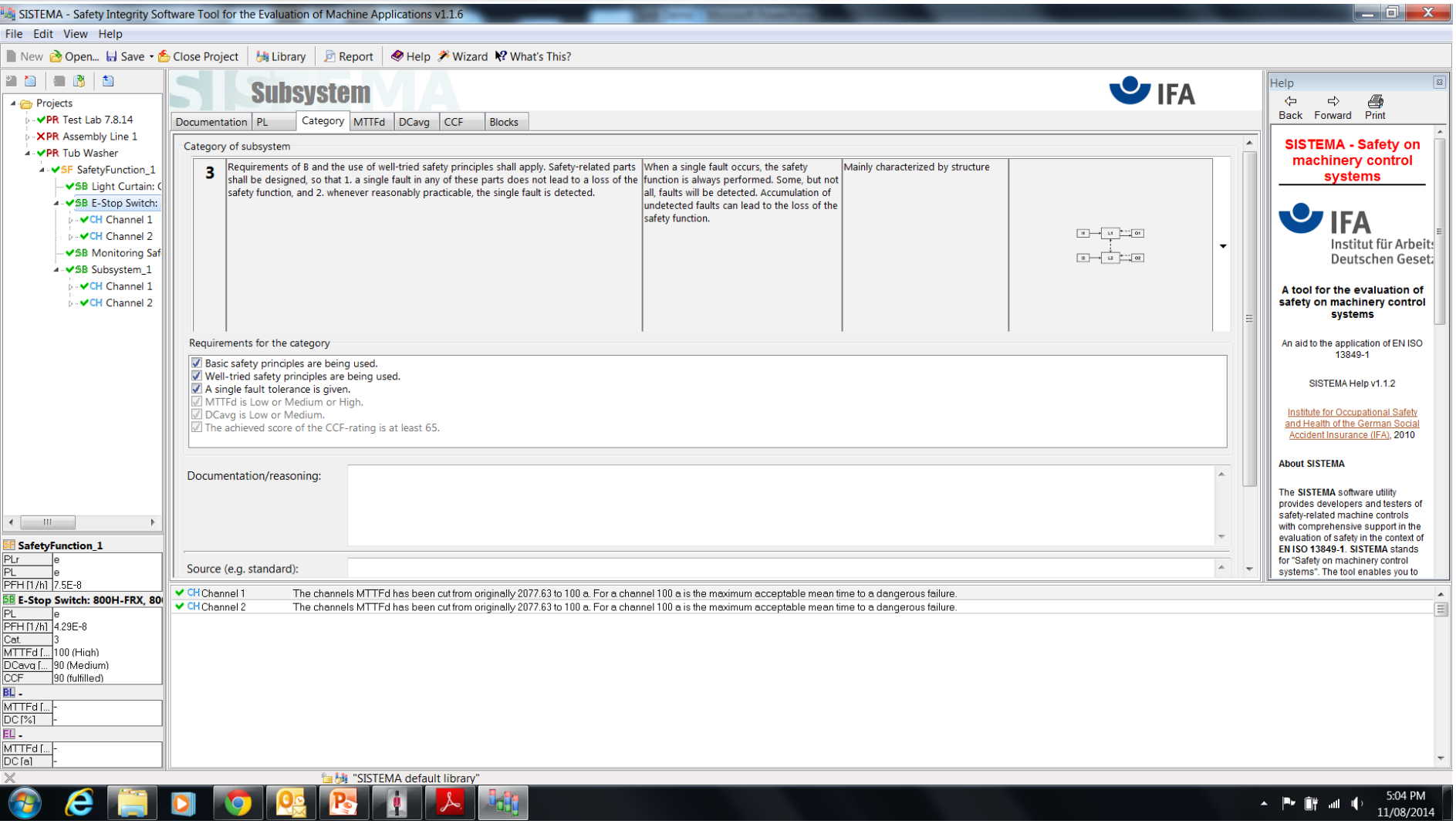
Safety Automation Builder



Safety Automation Builder


SISTEMA - Safety Integrity Software Tool for the Evaluation of Machine Applications v1.1.6
File Edit View Help
New Open... Save Close Project Library Report Help Wizard What's This?
Projects
PR Test Lab 7.8.14
PR Assembly Line 1
PR Tub Washer
Project
IFA
Documentation
Safety functions
There are messages with red status listed for this project (or it's subordinate basic elements). These point out either some unaccomplished conditions or inconsistencies.
Project name: Tub Washer
Project file name: C:\Users\david.cassidy\Desktop\Tub Washer 11.8.14.ssm
Last change: 11/08/2014
Checksum: -
Author: david.cassidy
Dangerous point/machine: INA255510721
Home folder for standards: ..\Standards
Home folder for documents: ..\Documents
Documentation:
Document:
Open
Help
Back Forward Print
SISTEMA - Safety on machinery control systems
IFA
Institut für Arbeits
Deutschen Gesetz
A tool for the evaluation of safety on machinery control systems
An aid to the application of EN ISO 13849-1
SISTEMA Help v1.1.2
Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA), 2010
About SISTEMA
The SISTEMA software utility provides developers and testers of safety-related machine controls with comprehensive support in the evaluation of safety in the context of EN ISO 13849-1. SISTEMA stands for "Safety on machinery control systems". The tool enables you to model the structure of the safety-related control components based upon the designated architectures, thereby permitting automated calculation of the reliability values
E-Stop Switch: 800H-FRX 800HC-FRX - Twist to release
The current configuration does not allow to calculate the PFH value using the standard.
E-Stop Switch: 800H-FRX 800HC-FRX - Twist to release
Not all the conditions of the chosen category are met. Please check the list of requirements in the tab 'category' of the subsystem.
"SISTEMA default library"
4:53 PM
11/08/2014

Safety Automation Builder


SISTEMA - Safety Integrity Software Tool for the Evaluation of Machine Applications v1.1.6
File Edit View Help
New Open... Save Close Project Library Report Help Wizard What's This?
Projects
PR Test Lab 7.8.14
PR Assembly Line 1
PR Tub Washer
SF SafetyFunction_1
SB Light Curtain:
SB E-Stop Switch:
CH Channel 1
CH Channel 2
SB Monitoring Saf
SB Subsystem_1
CH Channel 1
CH Channel 2
Subsystem
IFA
Documentation PL Category MTTFd DCavg CCF Blocks
Category of subsystem
3
Requirements of B and the use of well-tried safety principles shall apply. Safety-related parts shall be designed, so that 1. a single fault in any of these parts does not lead to a loss of the safety function, and 2. whenever reasonably practicable, the single fault is detected.
When a single fault occurs, the safety function is always performed. Some, but not all, faults will be detected. Accumulation of undetected faults can lead to the loss of the safety function.
Mainly characterized by structure
Requirements for the category
Basic safety principles are being used.
Well-tried safety principles are being used.
A single fault tolerance is given.
MTTFd is Low or Medium or High.
DCavg is Low or Medium.
The achieved score of the CCF-rating is at least 65.
Documentation/reasoning:
Source (e.g. standard):
Help
Back Forward Print
SISTEMA - Safety on machinery control systems
IFA
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A tool for the evaluation of safety on machinery control systems
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SafetyFunction_1
PLr e
PL e
PFH [1/h] 7.5E-8
E-Stop Switch: 800H-FRX, 80
PL e
PFH [1/h] 4.29E-8
Cat. 3
MTTFd [... 100 (High)
DCavg [... 90 (Medium)
CCF 90 (fulfilled)
BL -
MTTFd [... -
DC [%] -
EL -
MTTFd [... -
DC [a] -
CH Channel 1 The channels MTTFd has been cut from originally 2077.63 to 100 a. For a channel 100 a is the maximum acceptable mean time to a dangerous failure.
CH Channel 2 The channels MTTFd has been cut from originally 2077.63 to 100 a. For a channel 100 a is the maximum acceptable mean time to a dangerous failure.
"SISTEMA default library"
5:04 PM
11/08/2014

Safety Automation Builder- Summary

- Safety Automation Builder makes your project easier!
- Allows you to design your system, layout and product selection in the one document.
- Makes product selection less complicated

Questions / Notes